

# Studies on Alcoholic Beverage of Passion-Fruit Juice

By

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In research of the passion-fruit juice<sup>1)</sup> which was sent from Dr. D. SHERMAN, Dept. of Agricultural Chemistry, Hawaii University, we tried to make them into alcoholics by use three different strains of yeast in course of alcoholic fermentation. The various methods of manufacture were shown in the following four experiments.

**Analysis of passion-fruit juice:**— We suppose that the passion juice must be treated by Sharpless Centrifugal Machine in order to remove the solid matters, however we found a little amount of particles suspended in the juice.

**Table 1 Analysis of the passion-fruit juice**

components	%
Total sugar (as glucose)	12.10
Reducing sugar (as glucose)	11.70
Total acid (as acetic acid)	4.56
Volatile acid (as acetic acid)	0.66
Non volatile acid (as lactic acid)	5.85
Total nitrogen	0.23
Solid matters	15.46
Ethanol	0.16
Ester	0.71
pH	2

Sugar is analysed by the method of Bertrand<sup>2)</sup>. The total sugar is almost reducing sugar. The percentage of nitrogen is very small. And it is a fact that, as the percentage of total acid shows large or the pH value shows small, the juice is very sour in taste. Ethanol is contained in a very little quantity. Ethanol is analysed by the method of Kolthof<sup>3)</sup>.

**Cultures and fermentation:**— *Saccharomyces sake*, *Saccharomyces ellipsoideus*, and *Saccharomyces cerevisiae* are used on this study. They must be cultured at first for the use in

fermentation as follows: One loopful cell of each strain is inoculated in 5cc 5% Koji-extract respectively to culture at 30°C. for 48 hrs. After removed the part of limpid soln., we used the precipitated part in fermentation with the passion fruit juice filtrate which was prepared already as in the first experiment.

**The first experiment:**— As the natural odour of passion fruit juice is too strong to drink, we must remove all of the solid matters from the juice by a filter to make them mild before the fermentation. In the first experiment 5g of filter powder was added to 500cc passion juice and well stirred and then filtered by suction. We employed three Erlenmeyer flasks contained each 150cc filtrate and inoculated the culture yeast into them respectively to ferment for 8 days at 30°C. Table 2 presents the state of fermentation by means of the bubbles.

There are no remarkable changes in the components of passion fruit juice after fermentation expect the sugar consumed too much by the yeast, and a little changes showed in acid. The taste of the fermentation soln. is as sour as the original juice, it would not suit to be a beverage as it is.

**The second experiment:**— In the second experiment we add 2.50 g, calcium carbonate to one liter of passion juice in order to neutralize a part of acid from the juice and treated them as in exp. 1.

The decrease of sugar and increase of ethanol in *Sac. cerevisiae* happened later than others during the fermentation. The fermentation soln. contained the odour of the yeast and became bitter in taste by the calcium salt.

**The third experiment:**— 210cc filtrate of passion juice and 96.7g sugar diluted with 420cc water at first and then each 150cc of such soln.

**Table 2 State of fermentation in exp. 1**

Days	Sac. sake		Sac. ellipsoideus		Sac. cerevisiae	
	bubble	ppt. of cell	bubble	ppt. of cell	bubble	ppt. of cell
1	++	++	-	++	-	+
2	+	++	++	++	+	++
3	-	++	+	++	++	++
4	-	++	-	++	-	++

+ indicates the bubbles.  
 ++ indicates the bubbles more than the +.  
 - indicates no bubbles.

**Table 3 The results of the first experiment (30°C, 8 days)**

Days	Yeast	Red. sugar %	Total acid %	Vol. acid %	Unvol acid %	Ethanol %	Ester %
Before	fermentation	11.70	4.56	0.66	5.85	0.16	0.71
2	Sac. sake	1.17	4.58	0.06	6.78	3.94	4.10
	Sac. ellipsoideus	0.95	4.58	0.12	6.69	4.16	4.60
	Sac. cerevisiae	2.62	4.58	0.16	6.63	2.18	3.90
5	Sac. sake	trace	4.50	0.53	5.95	4.19	3.36
	Sac. ellipsoideus	trace	4.52	trace	6.78	4.30	3.29
	Sac. cerevisiae	trace	4.49	0.04	6.67	4.82	3.55
8	Sac. sake	trace	4.55	0.06	6.73	3.35	
	Sac. ellipsoideus	trace	4.65	0.06	6.75	3.92	
	Sac. cerevisiae	trace	4.55	0.06	6.73	4.06	

**Table 4 States of fermentation in exp. 2**

Days	Sac. sake		Sac. ellipsoideus		Sac. cerevisiae	
	bubble	ppt. of cell	bubble	ppt. of cell	bubble	ppt. of cell
1	++	++	+	++	-	++
2	+	++	++	++	++	++
3	-	++	-	++	+	++
4	-	++	-	++	-	++

are used for the experiment in fermentation at 30°C for 9 days.

In the third exp. the fermentation must keep longer than former because the conc. of sugar was concentrated. After 8 days in fermentation it contains about 1.35% sugar. The fermentation soln. of Sac. sake contains some odour of sake.

**The forth experiment:**— 500cc passion juice filtrate and 244g of glucose are diluted in one liter of water to make the medium for the

forth exp. We used three flasks contained each 500cc of such medium and inoculated each culture yeast into them respectively to ferment at 30°C for 10 days. After the first three days, each flask was added with 57g glucose during the fermentation.

Sample A, B, and C, contained about ten percent of alcohol, are produced from passion juice in fermentation by using each strain of yeast. They are almost the same in components except

**Table 5 Analysis of the results in the second fermentation exp. (30°C, 9 days)**

Days	Yeast	Red. sugar %	Total acid %	Vol. acid %	Non-vol. acid %	Ethanol %	Ester %
Before	fermentation		1.32				
2	Sac. sake	trace	1.32	0.09	1.84	4.78	0.39
	Sac. ellipsoideus	trace	1.32	0.09	1.84	4.81	0.31
	Sac. cerevisiae	5.15	1.32	0.70	0.31	2.71	1.61
4	Sac. sake	trace	1.32	0.06	1.89	4.96	0.28
	Sac. ellipsoideus	trace	1.32	0.06	1.89	4.94	0.11
	Sac. cerevisiae	trace	1.32	0.09	1.84	4.94	0.11
9	Sac. sake	trace	1.36	0.06	1.90	4.49	0.26
	Sac. ellipsoideus	trace	1.30	0.06	1.86	4.31	0.17
	Sac. cerevisiae	trace	1.35	0.07	1.92	4.78	0.15

**Table 6 States of fermentation in experiment 3**

Days	Sac. sake		Sac. ellipsoideus		Sac. cerevisiae	
	bubble	ppt. of cell	bubble	ppt. of cell	bubble	ppt. of cell
1	+	+	+	-	+	+
2	++	++	+	+	+	+
3	++	++	+	+	+	++
4	+	++	+	++	+	++
5	+	++	+	++	+	++

**Table 7 Analysis of the fermentation soln. in the third exp. (30°C, 8 days)**

Days	Yeast	Red. sugar %	Total acid %	Vol. acid %	Non-vol. acid %	Ethanol %	Ester %
Before	fermentation	16.30	1.44				
2	Sac. sake	5.08	1.33	0.28	1.57	5.91	1.95
	Sac. ellipsoideus	6.18	1.38	0.51	1.30	5.15	1.36
	Sac. cerevisiae	10.75	1.38	0.51	1.30	2.15	1.29
5	Sac. sake	1.55	1.31	0.17	1.71	7.46	3.29
	Sac. ellipsoideus	1.75	1.31	0.17	1.71	7.49	3.27
	Sac. cerevisiae	1.67	1.31	0.17	1.71	7.62	3.36
8	Sac. sake	1.50	1.31	0.13	1.77	7.13	3.12
	Sac. ellipsoideus	1.50	1.31	0.15	1.74	7.15	3.04
	Sac. cerevisiae	1.36	1.31	0.15	1.75	7.14	3.47

**Table 8 States of fermentation in exp. 4**

Days	Sac. sake		Sac. ellipsoideus		Sac. cerevisiae	
	bubble	ppt. of cell	bubble	ppt. of cell	bubble	ppt. of cell
1	++	-	-	-	-	-
2	++	+	+	+	++	+
3	++	+	++	+	++	++
4	+	++	-	++	-	++
10	-	++	-	++	-	++

**Table 9 Analysis of the results of fermentation in the forth exp. (30°C, 10 days)**

	Red. sugar %	Total acid %	Vol. acid %	Non-vol. acid %	Ethanol %	Ester %
Before fermentation	14.64	1.28				
8.15gr/100cc sugar was added during the fermentation						
Samle A (Sac. sake)	2.25	1.28	0.16	1.68	9.41	1.16
Sample B (Sac. ellip.)	2.00	1.28	0.23	1.57	9.58	1.16
Sample C (Sac. cerev.)	2.04	1.28	0.16	1.68	9.46	1.16

the flavours are a little different each other by the different strain of yeast.

### Summary

We found that the *Saccharomyces sake* works in fermentation earlier than other strains of yeast. As the strain of *Saccharomyces sake* is used, the product possesses somewhat flavour which we feel in Japanese wine. When the *Saccharomyces ellipsoideus* or *Saccharomyces cerevisiae* is used, the flavour of the product is particular respectively.

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### Reference

- 1) Taiwan Agricultural Experiment Station : Agricultural Handbook in Taiwan, 538, 1944.
- 2) Bertrand : Handbuch der Biologischen Arbeitmethoden, 174, abt 1, Teil 5.
- 3) Kolthof : Journal of Biological Chemistry, 115, 47, 1936.

### 摘 要

#### 中浜敏雄：パッション果汁液より醸造せる酒精飲料

passion fruit の果汁を醸酵してアルコール飲料の醸造を試みた。果汁は刺激的な香りと強い酸味とを有し11.70%の直接還元糖(葡萄糖として)を含有して居た。適当な醸酵法の一例を挙げると次の如くである。

醸酵基質として果汁を約三倍に稀釈したものに直接還元糖が22.79%になる様葡萄糖を附加した。但し附加の方法は酵母を糖に馴致せしめる目的で二回に分けて行つた。

酵母は *Sac. sake*, *Sac. ellipsoideus* 及び *Sac. cerevisiae* の純粋培養を別々に接種した製品は三種の酵母に依る製品に就てアルコール、糖、酸、エステル等の濃度に於て殆んど認む可き差は無いが、三者夫々独特の風味を有する酒精飲料を得た。

*Sac. sake* の場合は清酒に感ぜられる風味を僅かながら認め得た。*Sac. ellipsoideus* の場合は最も円味のある風味を感じた。