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Quality Changes in 'Hayward' Kiwifruit Wine Fermented by Different Yeast Strains

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효모에 따른 참다래 'Hayward' 와인의 품질 변화

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Abstract

The yeast strains used for fermentation are known to influence the qualities of wine. We investigated the effects of fermentation using different yeast strains on the properties of wine produced from 'Hayward' kiwifruit (*Actinidia deliciosa*). The physicochemical characteristics of wine produced using various yeast strains for fermentation were also analyzed. *Saccharomyces cerevisiae* Gervin No.5 strain (GVN), *S. bayanus* Lavin strain EC1118 (EC1118), and *S. cerevisiae* Red star Davis No. 796 (No.796) are commercial dry yeast strains selected for optimization of fermentation. Although the soluble solid contents of samples fermented by all three yeast strains decreased by a similar extent, the levels of alcohol production differed, particularly during the first week of fermentation. Use of the GVN strain resulted in the highest alcohol concentration (13.8%, v/v), whereas fermentation with No.796 and EC1118 strains yielded alcohol contents of 13.0% and 12.5% (both v/v), respectively. Upon sensory evaluation, GVN-fermented wine had a strong taste and bitterness, with high acid and alcohol contents. Wine fermented using No.796 had a chemical profile similar to that of GVN-fermented product, but the taste remained sweet, consistent with the lower alcohol content. EC1118-fermented wine was soft and sweet in taste, high in flavor, and had a low alcohol content. Total phenolic levels and antioxidant activities in wine fermented by EC1118 were significantly higher than in wines prepared using No.796 or GVN. When previously described characteristics were additionally considered, EC1118 was selected as an optimum strain for further study. In conclusion, fermentation of kiwifruit using different yeast strains yielded wines with distinct characteristics. The yeast strain EC1118 had the most desirable properties, and is considered suitable for kiwifruit fermentation. Valuable attributes of wine fermented by this yeast include overall sensory acceptance, an appropriate level of total phenolics, and good antioxidant activity.

Key words : kiwifruit, wine, fermentation, yeast strains, antioxidant activity

Introduction

Techniques for kiwifruit processing such as washing, cleaning, peeling, grading, slicing, juicing, pulping, drying, canning, freezing and freeze-drying have been proposed by a number of previous studies (1-3). In general, lot of studies were focused on preserving higher quality of fresh kiwifruit, such as methods of improving storage quality (4-7) and detecting of their bioactive compounds such as proteolytic enzymes (8) and anti-microbial activity (9) rather than on the proposal of new ways of processing this fruit. Besides, kiwifruit softens easily, lose its quality during storage. It is mostly consumed fresh that caused marketing place problems due to uneven storage temperature, low humidity and ethylene production (2). The deterioration of quality during storage needs to be overcome to expand the domestic consumption of kiwifruit. Therefore, kiwifruit wine production is might

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be the optional answer for a new way of kiwifruit industry.

Since, kiwifruits constitute the raw material for the wine production and its composition is important for the product's quality and profitable manipulation. Kiwifruit has important quantities of proteins (3), carotenoids, phenyloic compounds, sufficient quantities of minerals (P, K, Ca, Mg) and aromatic components (mainly esters, alcohols, aldehydes, and ketones) (4). Fruit polyphenols, which contribute to wine color and to other sensorial characteristics of wines such as bitterness and astringency, comprise both flavonoids and non-flavonoids (10). Furthermore wine contains alcohol and its protective effects against cardiovascular diseases seem also to be the related to the content of ethanol (11-12). These beneficial effects of wine have been attributed to its content of phenolic compounds, which are well-known antioxidant compounds. Many studies have been finding to support the results from several experimental and epidemiological studies, suggesting that the supply of antioxidant phenols through a moderate daily consumption of wines may provide additional protection against in vivo oxidation of cellular biomolecules (13).

The choice of selection on a yeast strain is an important factor since these microorganisms have the capacity to retain or adsorb phenolic compounds (14) and, on the other hand, yeast may contribute to stabilizing wine color (15), as a result of participating in the formation of vitisins during fermentation or liberating mannoproteins that have the capacity to bind to anthocyanins and tannins, protecting them from precipitation.

There is a little information about yeast strainseffect on physiological characteristics and quality in kiwifruit wine production. Therefore, in this part, comparative study on 3 different of yeast strains was focused. Conditions under which white table wines with consistent high quality can be produced from kiwifruit have been determined.

Materials and Methods

Materials

Kiwifruits which belong to 'Hayward'cultivar were picked at a commercial maturity stage from Muan country orchard, Jeonnam, Korea and immediately transferred to store at the 0℃ cool storage room, Pomology Laboratory, Mokpo National University. Their harvest dates were 28th October 2008. Three different commercial yeasts were used: *Saccharomyces cerevisiae* Gervin No.5 strain (GVN, France), *Saccharomyces bayanus* Lavin strain EC1118 (Prise de Mousse, Canada) and *Saccharomyces cerevisiae* Red star Davis No.796 Premier CuvéeLesaffre Yeast Corporation 433 (E. Michigan Street, Milwaukee, WI 53202, USA)

Sample preparation

Kiwifruits were selected on the basis of uniformity and absence of damage. Fruits with defects were discarded and washed in plenty of running water in order to remove foreign material from the skin. The recipe were adapted from Terry Gary's the joy of home winemaking, Withy and Lodge (16) and Soufleros *et al.* (17) for making wine 7.5 L · batch^{-1}. The wine processing methods was presented in Fig. 1. Firmness, soluble solid content and pH were checked to classify its quality characteristics. Washed kiwifruits were peeled skin out and coarsely pulped in blender for 2,730 g sample. After fruit blending, 4.5 g tartaric acid, 0.45 g Tannin and 6 g of ammonium phosphate as a yeast nutrient were added in blended kiwifruit and put in to a primary jar (fermented jar, Italy).

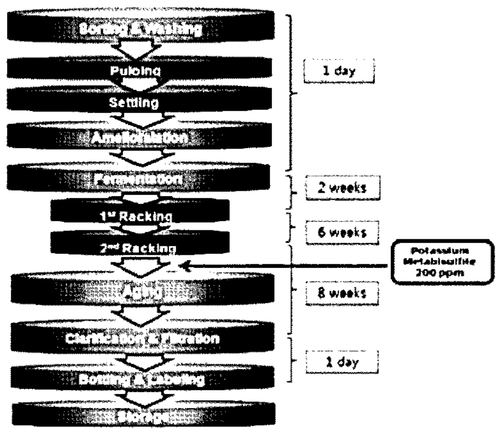

Fig. 1. Kiwifruit wine processing methods.

Amelioration

Meanwhile, 1,540 g finely granulated sugar was mixed into the 5.4 L hot water, stirred occasionally to dissolve The syrup was poured into the primary jar over the fruit when all sugar was dissolved. Cover the primary jar with clean cloth and set aside to cool. When room temperature, 1.72 g of pectin enzymes was added and stirred.

Fermentation

In brief, after recovery primary jar and wait for 1 hr, 1.5 g of yeast diluted in 15 mL of 40℃ water was added, stirred and refitted with airlock. In order to determine the characteristic of yeast effective, the result was compared by using three different commercial yeasts. The samples were fermented at 14℃ for 2 weeks. The fermented samples were then racked into the secondary jar in order to develop the quality and reduce the risk of sluggish fermentation and were aged at the same condition. After 4 weeks of fermentation, samples were racked again into the new jar, stabilized with 0.4 g potassium metabisulphite, and were kept for 3 months. The samples were filtrated, bottled, and stored at 14℃ until investigation.

Quality characteristics

The kiwifruit juice or wine was analyzed for SSC. The soluble solid was determined by a refractometer (Model 0-32 Brix, Atago, Japan) and was expressed in Brix units. Alcohol contents were analyzed using the Gay Lussac Table by distilling and adjusting 100 mL of fermented sample to 15℃. pH was measured with a pH meter (Model 720A, Orion,USA). For TA measurement, total acidity was measured by titrating a sample (4 mL of juice or wine diluted with 20 mL of distilled water) with 0.1 N NaOH. Wine color was measured with CR-400 Chroma meter equipped with CR-S4w utility software (Konica Minolta Sensing Inc., Japan) and expressed as 'L', 'a', and 'b'

Total phenols.

The total phenol concentration was determined spectrophotometrically according to the Folin-Ciocalteu colorimetric method (18). The total phenol concentration was calculated from the calibration curve, using gallic acid as standard and the result were expressed as mg of gallic acid equivalents per 100 g fresh fruit measured at 765 nm under spectrophotometer (Hewlett-Packard, model 8452A, Rockvile, USA).

Antioxidant activity.

Reagents of Trolox (6-hydroxy-2,5,7,8-tetramethyl chroman-2-carboxylic acid), 2,2'-azonobis (3-ethylbenzothiazolinw-6-sulphonic acid) (ABTS) ,Potassium persulfate ($K_2S_2O_8$) and other routine chemicals were purchased from Sigma Chemical Co.(St. Louis, MO, USA). The antioxidant activities were determined using ABTS with $K_2S_2O_8$ and with MnO_2. ABTS radical cation was generated by the interaction of ABTS (250 mM) and $K_2S_2O_8$ (40 mM). The percentage decrease of the absorbance at 734 nm was calculated and plotted as a function of the concentration of the extracts and of Trolox for the standard reference data in terms of the Trolox equivalent antioxidant coefficient (TEAC) (19).

Mineral contents analysis

Filtered samples were measured mineralcontents (P, K, Ca, Mg, Na,and Fe) by Atomic absorption spectrophotometer (AVANTA, GBC Scientific Equipment Pty Ltd, Australia).

Sensory evaluation

The taste of wine was analyzed by sensory after fermentation. Sensory evaluation was carried out in sensory laboratory by 12 qualified panelists. Taste quality of wine was evaluated by affective test of sweetness, sourness, bitterness, astringency, and total acceptation in Hedonic scale method which was 1-5 rating scale (1=severely bad, 1=bad, 3=moderate, 4=good, and 5=excellent).

Data analysis

To verify the statistical significance of the studied parameters, means,and standard deviation (means ± S.D.) of three measurements were determined.

Results and Discussion

This part was investigated the quality characteristics of kiwifruit wine during low temperature aging on aging alcohol fermentation strains.

Wine quality characteristics

Changes of the quality characteristics of kiwifruit wine during fermentation using different yeast strains were shown in Fig. 2. The soluble solid content of all samples were decreased while the alcohol production was increased especially at the first week after fermentation. For soluble solid content in all samples started at 22 °Brix and at the end of fermentation, the soluble solid content were reduced to 6, 6.8, and 7.3 °Brix in wine fermented by *Saccharomyces cerevisiae* Gervin No.5 strain (GVN), *S. cerevisiae* Red star Davis No.796 (No.796), and *S. bayanus* Lavin strain EC1118 (EC1118), respectively. As can be seen from Fig. 2., At the end of fermentation, all of strain produced all most the same level of alcohol concentration. The strain that produced the highest alcohol concentration was GVN with 13.8 %, followed by No.796 and EC1118 with 13.0 and 12.5%, respectively.

The pH and total acidity were similar for all strains that the initial pH of wine was quite high, around 3.67 and after fermentation the pH in all strains was slightly decreased (Fig. 2.). Changes of pH were varying from 3.67 to 3.49. It

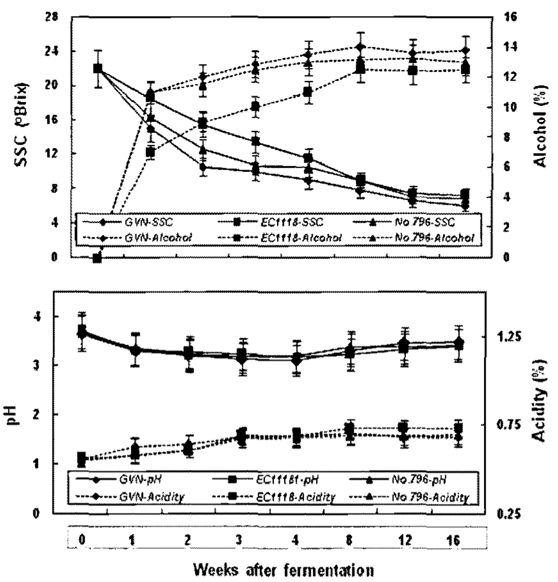

Fig. 2. Changes of quality characteristics (soluble solid content, alcohol content, pH and acidity) of kiwifruit wine fermented by different yeast strains.

GVN: *S. cerevisiae* Gervin No.5 , EC1118: *S. bayanus* Lavin EC1118 strain, No.796: *S. cerevisiae* Red Star Davis No.796. Values are means±SD (n=3).

was quite similar with the result of Soulfleros. E.H. *et al.* (17) reported the pH value of kiwifruit wines were 3.40 to 3.55. Lun and Wang (20) also reported the level of pH, ranged from 3.1 to 3.96 which it quite a wide range. The total acidity, expressed as citric acid, ranged from 0.55 to 0.57% for the kiwifruit wine at initial time and then kept slightly increased till 16 weeks. At the end of fermentation the total acidity in GVN, EC1118 and No.796 were 0.68, 0.72, and 0.69%, respectively.

Roh H.I. *et al.* (21) reported using 12 different commercial yeast strains on the characteristic of fermentation and grape wine quality. There are two of strains in this experiment were studied (EC1118 and No.796). Their results showed the same trend of fermentation characteristics from our study that No.796 showed higher in alcohol production rate and pH than EC1118.

For wine color quality, as can be seen from Table 1., at the initial state, L value from all wines started at 72 and then continued to increase to 93.79, 93.6 and 92.95 at the end of fermentation in wine fermented by GVN, No.796, and EC1118, respectively. There was no different on a value *significantly in all wine samples which a value decreased* steadily from 1.74 to -0.16 after the 2 weeks of fermentation and then remained constant until the end of the period studied. b value showed high yellow to approximately 9 and then continued to decrease to approximately 7 after 16 weeks of fermentation.

However, this result was contrasted with the report from Jang S. Y. *et al.* (22) that during aging (after 4 weeks of fermentation), L and b values decreased while a value increased extremely. This phenomenon happened from the different wine processing method. They reported that before aging (after 12 days of fermentation), the kiwifruit wine samples were filtered with paper filter (Whatman No.3) and passed through 0.45 μm-membrane filter and storage at 15℃ for 5 months for wine aging. While, our method was kept the wine for fermentation, and the 1st and the 2nd Racking were done after 2 weeks and 4 weeks of fermentation. After that, wine samples were aging for the next 3 months before micro-membrane filtering and bottling.

Total phenols and antioxidant activity

Changes of total phenols and antioxidant activity of kiwifruit wine during fermentation using different yeast

Table 1. Hunter values of kiwifruit wine fermented by different yeast strains

Type of fermented yeast strains[1]	Hunter value	Fermentation Time (weeks)							
		0	1	2	4	6	8	12	16
	L	72.25±3.61	92.36±4.62	92.95±4.65	93.74±4.69	94.27±4.71	93.97±4.70	93.78±4.69	93.79±4.69
GVN	a	1.7±0.04	-0.16±0.01	-0.07±0.00	-0.15±0.02	-0.12±0.00	-0.12±0.00	-0.14±0.00	-0.15±0.02
	b	8.75±0.44	7.63±0.38	7.46±0.37	7.34±0.37	7.25±0.36	6.22±0.31	6.16±0.30	6.23±0.31
	L	71.38±3.57	86.05±4.30	89.65±4.48	90.64±4.53	93.59±4.68	90.8±4.54	90.59±4.53	92.95±4.65
EC1118	a	1.74±0.09	-0.20±0.02	-0.25±0.03	-0.22±0.02	-0.35±0.00	-0.13±0.00	-0.17±0.02	-0.15±0.02
	b	8.72±0.44	7.53±0.38	7.4±0.37	7.28±0.36	7.22±0.34	6.29±0.31	6.15±0.29	6.23±0.30
	L	72.93±3.65	90.73±4.54	91.41±4.62	92.4±4.25	92.23±4.62	92.43±4.52	93.59±4.62	93.67±4.68
No.796	a	1.66±0.08	-0.11±0.00	-0.32±0.02	-0.30±0.03	-0.33±0.02	-0.36±0.02	-0.13±0.00	-0.16±0.02
	b	8.73±0.42	7.69±0.35	7.31±0.37	7.46±0.35	7.31±0.36	6.32±0.31	6.13±0.35	6.18±0.33

[1]GVN: *S. cerevisiae* Gervin No.5 , EC1118: *S. bayanus* Lavin EC1118 strain, No.796: *S. cerevisiae* Red Star Davis No.796. Values are means±SD (n=3).

strains were shown in Fig. 3. The results showed that total phenols and antioxidant activities of wine fermented with all strains during fermentation were slightly decreased. Total phenols and antioxidant activity in finished wine fermented by EC1118 were 195.84 mg · L^{-1} and 14,366 mM TE · L^{-1} that significantly higher than in other yeast strains, followed by wine fermented by No.796 and GVN, respectively.

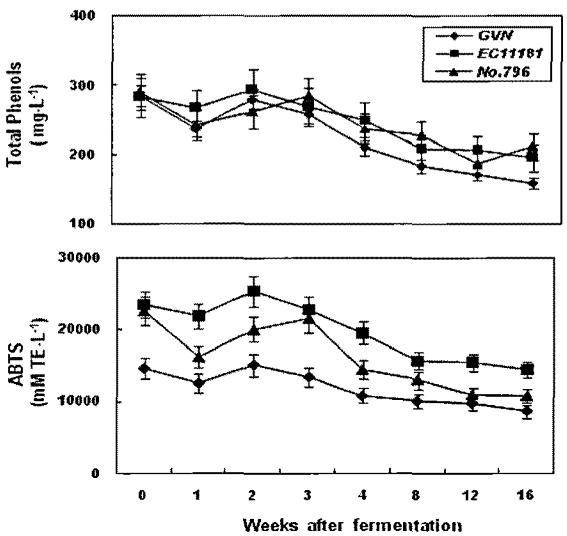

Fig. 3. Changes of total phenols and antioxidant activity of kiwifruit wine fermented by different yeast strains.

GVN: *S. cerevisiae* Gervin No.5 , EC1118: *S. bayanus* Lavin EC1118 strain, No.796: *S. cerevisiae* Red Star Davis No.796. Values are means±SD (n=3).

However, the drop in total phenol level could have been due to the fact that they were highly reactive compounds which are involved in condensations and polymerization reactions as well as to the formation of oxidative products and precipitations (23) Besides, the yeasts may affect the wine chromatic profile and phenolic content both during fermentation and wine aging, and may be used as the tool during wine making for obtaining stable and highly colored wines.

Total phenols and antioxidant activities showed the same relation (Fig. 4). A significant linear and positive relationship was observed between total phenols and antioxidant activity with a high correlation coefficient (r^2) of 0.984, 0.986, and 0.979 in GVN, EC1118, and No.796, respectively. Our results of total phenols and antioxidant activities for kiwifruit wine were similar to those found by Rupasinghe Vasantha and Steve (24) and Gil *et al.* (25) who have shown high total phenols increases antioxidant activity. They have reported a strong correlation (r^2 = 0.93 to 0.97) between total phenols and antioxidant activities in 14 different fruit wines included from grape and in fresh fruits such as peaches and plums.

It was important to examine the correlation between the content of the total phenols and antioxidant activities because some authors have reported that there is no correlation between the content of these main antioxidant compounds. These contradiction claims were due to different assays with different free radical generators, end-points and quantification systems could affect and show in different results and different relations between total phenols and antioxidant activity(26).

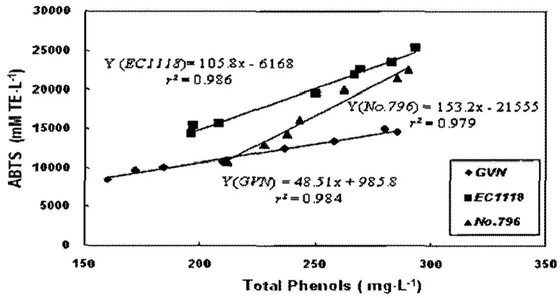

Fig.4. Relationship between total phenols and antioxidant activity of kiwifruit wine fermented by different yeast strains.

GVN: *S. cerevisiae* Gervin No.5 , EC1118: *S. bayanus* Lavin EC1118 strain, No.796: *S. cerevisiae* Red Star Davis No.796. Values are means±SD (n=3).

Mineral contents

Mineral contents of kiwifruit wine during fermentation using different yeast strains were shown in Table 2. The concentrations of most mineral contents in finished wine product were similarly with fresh kiwifruit. As can be seen, the concentrations of mineral elements in each sample were not significantly different among wines using different alcohol fermentation strains. However, during fermentation most of minerals were changed. Potassium (K) was the most predominant element present in all samples that ranged 503 $\mu g \cdot g^{-1}$ before fermentation and then increased to 905 $\mu g \cdot g^{-1}$ after 16 weeks of fermentation. Sodium (Na) was continued to increase from 3.1 to 6.99 $\mu g \cdot g^{-1}$. On the other hand, Calcium (Ca) and Magnesium (Mg) were slightly decreased after 8 weeks of fermentation. Iron (Fe) was the minor minerals present decreased from 0.22 to 0.05 $\mu g \cdot g^{-1}$ at the end of fermentation.

Our results on the content of most minerals in all wine samples have profiles similar with other wines of different fruit sources except in Sodium content that much lower (6.99 $\mu g \cdot g^{-1}$) than other wine from different fruit sources that ranged 23 to 66 $\mu g \cdot g^{-1}$ (24). It appears that the trace element patterns of wines from different fruit sources have a distinct composition and could be used as a fingerprint to identify some unique categories. However, the influence of other factors such as geographical environment, soil chemistry,

Table 2. Mineral contents of kiwifruit wine fermented by different yeast strains

Type of fermented yeast strains[1)]	Fermentation time(weeks)	Mineral Contents ($\mu g \cdot g^{-1}$)				
		Na	Fe	Ca	Mg	K
GVN	0	2.95±0.15	0.20±0.21	43.32±2.17	25.59±1.28	503.25±25.16
	1	3.25±0.16	0.18±0.01	44.45±2.22	23.33±1.17	533.61±26.68
	2	3.02±0.15	0.06±0.01	53.35±2.67	30.50±1.53	435.6±721.78
	4	2.55±0.13	0.03±0.01	40.05±2.00	28.80±1.44	312.15±15.61
	6	3.03±0.13	0.03±0.01	42.25±2.11	26.65±1.33	335.68±16.78
	8	3.88±0.15	nd[2)]	38.89±1.94	24.44±1.22	475.58±23.78
	12	3.33±0.17	nd	31.44±1.57	23.35±1.17	589.08±29.45
	16	6.25±0.31	nd	31.14±1.56	24.43±1.22	772.05±38.60
EC1118	0	3.12±0.16	0.22±0.01	46.67±2.33	28.59±1.43	465.89±23.29
	1	3.68±0.18	0.15±0.01	46.53±2.33	25.55±1.28	515.43±25.77
	2	2.75±0.14	0.07±0.01	55.33±2.77	27.85±1.39	465.99±23.30
	4	3.14±0.16	0.04±0.01	39.25±1.96	25.55±1.28	380.13±19.01
	6	3.44±0.17	0.05±0.01	40.55±2.03	23.59±1.18	450.02±22.50
	8	3.96±0.20	nd	36.59±1.83	26.88±1.34	426.62±21.33
	12	3.40±0.17	nd	33.55±1.68	26.42±1.32	660.78±33.04
	16	6.99±0.35	nd	31.85±1.59	25.84±1.29	905.53±45.28
No.796	0	2.93±0.15	0.22±0.01	47.75±2.39	27.85±1.39	450.2±222.51
	1	3.53±0.18	0.14±0.01	43.59±0.18	24.85±1.24	525.33±26.27
	2	2.85±0.14	0.03±0.01	48.67±2.43	28.99±1.45	401.33±20.07
	4	2.89±0.14	nd	40.54±2.03	26.83±1.34	365.17±18.26
	6	3.24±0.16	nd	38.99±1.95	25.22±1.26	395.96±19.80
	8	4.37±0.22	nd	37.69±1.88	27.45±1.37	442.23±22.10
	12	2.91±0.15	nd	21.15±1.06	26.42±1.32	643.73±32.19
	16	6.62±0.33	nd	26.92±1.35	24.13±1.31	838.24±41.91

[1)]GVN: *S. cerevisiae* Gervin No.5 , EC1118: *S. bayanus* Lavin EC1118 strain, No.796: *S. cerevisiae* Red Star Davis No.796. Values are means±SD (n=3).
[2)]nd: not detection.

viticulture practices and processing methods needs to be understood.

Sensory evaluation

The sensory value of kiwifruit wines was showed in Fig.5. Wine fermented by EC1118 showed the highest of total quality scores in almost the time during fermentation followed by wine fermented by GVN while wine fermented by No.796 showed the lowest score. However, at the end of fermentation, all wines showed the similar scores of total acceptance. Wine fermented by EC1118 showed a soft taste of bitterness and low astringency, high flavor and low alcohol content. Wine fermented by No.796 remained sweet taste while had a strong taste of astringency, strong bitterness, and high alcohol content. Wine fermented by GVN had a profile like wine fermented by No.796 but higher in alcohol content and higher in acid.

As bitterness and astringency are also two of main sensory attributes of wine. They are mainly induced by phenolic compounds and especially tannin (27). As can be seen from total phenol and sensory attribute of each sample, we found that No.796 effected on wine quality by showing strongest astringency, strong bitterness, and also containing high total phenols compared with other samples. The bitterness increase could be directly related to the increase of bitter compound concentration (22). For GVN that effected on highest alcohol and highest acid, the astringency perception was lowered than other samples because it was directly related to pH and alcohol level which affected to lower observing of astringency (28). Besides, we also found that there was a reduction trend in astringency observed during fermentation in all samples while increasing in alcohol production. It might be explained by the increase in viscosity (29).

In conclusion, the importance of yeast in winemaking is extensively known since they are responsible for the transformation of sugars into ethanol and for the formation of the most significant aroma compounds in wines. However, they may also participate in wine color and this role is usually not taken into account in the wine industry. The quality characteristics of kiwifruit wine on several alcohol fermentation strains showed similarly; however, EC1118 was overall the most suitable especially in term of functional properties such as total phenolics and antioxidant activity. Therefore, EC1118was selected as the optimum strain for the further study. Lastly, some ideas and suggestions for future studies are put forward such as skin contact, fruit maturity degree, etc.

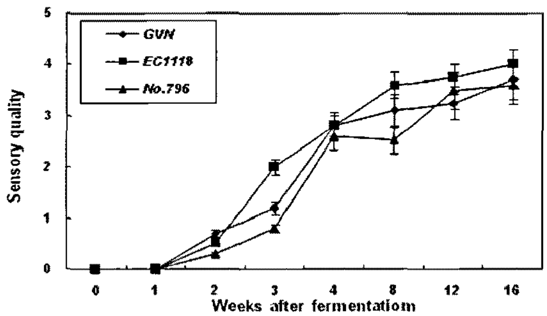

Fig.5. Changes of sensory quality of kiwifruit wine fermented by different yeast strains.

GVN: *S. cerevisiae* Gervin No.5 , EC1118: *S. bayanus Lavin* EC1118 strain, No.796: *S. cerevisiae* Red Star Davis No.796. Values are means±SD (n=3).

요 약

참다래로 만든 'Hayward' 와인 제조에 적합한 효모 선발을 위해서 3종의 효모에 의한 발효과정에서의 물리화학적 특성 변화를 조사 분석하였다. 사용된 효모는 *Saccharomyces cerevisiae* Gervin No.5 strain (GVN), *S. bayanus* Lavin strain EC1118 (EC1118), 그리고 *S. cerevisiae* Red star Davis No.796 (No.796)은 와인 발효에 가장 적합하여 상업적으로 이용되고 있는 효모이다. 이 세 효모에 의해 발효된 샘플의 당도 함량은 비슷하게 감소하였으나, 알코올 생산량만 발효 첫 주에 큰 차이가 있었다. 효모중 GVN이 13.8%로 알콜농도가 가장 높았고, 반면에 No.796과 EC1118은 각각13.0%와 12.5%로 상대적으로 알콜함량이 낮았다. 관능평가에서 GVN은 높은 산과 높은 알콜함량을 가지고 있고, 강한 풍미와 쓴맛을 가진 것으로 평가되었다. No.796은 GVN과 유사하지만 낮은 알콜함량과 함께 단맛이 있었다. EC1118은 높은 풍미, 단맛과 낮은 알콜함량으로 부드러운 맛으로 평가되었다. EC1118에 의해 발효된 와인의 총페놀과 항산화 활성은 다른 효모보다 높았다. 따라서 본 연구에서EC1118이 최적의 효모로 선발되었다. 다른 2종의 효모를 사용한 참다래 발효 와인은 각각 다른 품질 특성을 나타내었다. EC1118효모는 참다래 발효에 가장 바람직한 특성을 가지고 있었다. 이러한 특성은 주로 총페놀과 항산화 활성과 같은 건강기능성과 높은 관능적 기호도를 가지고 있었다.

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