Product of lychee (Hong Huay) and plum (Julie) wine making process at Baan Obb T. Maung Kaii A. Mae Tang Chiang Mai

By
Mr.Karn Kittisuntornwat
ID. 431-8480

A special project submitted to the faculty of Biotechnology.
Assumption University in part of fulfill of the requirements for
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By : Mr. Karn Kittisuntornwat

Advisor : Dr. Viyada Kunathigan

Level of Study : Bachelor of Science

Department : Agro-Industry

Faculty : Biotechnology

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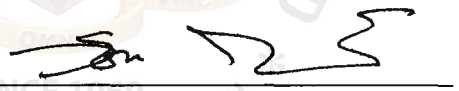

Advisor

(Dr. Viyada Kunathigan)

ABSTRACT

This project was aimed to study a process of making fruit wine in pilot scale in order to add value to the local fruit (lychee Hong Huay cultivar and plum Julie cultivar) at Baan Obb T.Maung Kaii A. Mae Tang Chiang Mai (บ้านออบ ต.เมืองก๋าย อ.แม่แตง จ.เชียงใหม่). Due to over supply of lychee and plum in the northern part of Thailand. The prices of the crops were very low, especially for the orchard. The lychee-plum wine was made using various ratio of lychee to plum. The chemical compositions of lychee, plum, lychee: plum (1:1), and lychee: plum (2:1) wines were studied. There were Total soluble solid (TSS), pH, percent alcohol, total acidity, volatile acidity and reducing sugar; and the acceptability of colour, clarity, odor and flavor by sensory evaluation.

From the results, the chemical composition of each ratio was determined after fermentation. There were TSS 5-8 °Brix, pH 2.70-3.05, alcohol 11.75-12.50%(v/v), reducing sugar 2.50-2.75%(w/v), VA 0.02-0.05% (g/100 ml) and TA 0.32-0.66% (g/100 ml). The plum wine sample has analyzed to have the highest fermentation efficiency according tosugar conversion rate and ethanol production.

Twenty panelists and 5-point hedonic scale were used for sensory evaluation of the products. The lychee-plum wine (2:1) had the highest scores as 4.0, 4.0, 3.7, 3.7, and 4.05 for colour, clarity, odor, flavor, and overall liking, respectively.

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Mr.Karn Kittisuntornwat

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INTRODUCTION

The lychee is the economic fruits in the northern part of Thailand such as Chiang Rai, Chiang Mai, Nan, Payao. Thailand used to export fresh and canned lychee to Singapore, Malaysia, Hong Kong and the USA. But nowadays, it has the over supply problem that ruined the economical value of both lychee and plum. A solution of this problem is to approve and apply the fruit product to get the alternative way to do the business. And this region, Baan Obb T.Maung Kaii A. Mae Tang Chiang Mai (บ้านออบ ต.เมืองก๋าย อ.แม่แตง จ.เชียงใหม่), has the appropriate weather for winemaking. So the wine that make from the local fruit is the interesting choice.

The main objective for this project is to use lychee (Hong Huay cultivar) and plum (Julie cultivar), which are the fruits that face this problem, to make wine in order to add value to the products and also solve the oversupply problem.

OBJECTIVES

The objectives of this study are:

1. To study the process of making lychee plum wine in order to add value to the local fruits of Baan Obb T.Maung Kaii in Chiang Mai that has excess yield each year.
2. To study the suitable ratio of lychee (Hong Huay cultivar) and plum (Julie cultivar) wine making process.
3. To study the chemical property and consumer acceptance of the lychee-plum wine.

LITERATURE REVIEW

1. Lychee

Figure 1: Lychee (*Litchi chinensis Sonn.*)

The Lychee or Lichi or Litchi (*Litchi chinensis Sonn.*) is the most famous one in a group of edible fruits of the soapberry family, Sapindaceae. (Soapberry is a tree of the genus Sapindus whose fruit is rich in saponin that is a poisonous glucosidal.) The lychee is native to low elevations of the provinces of Kwangtung and Fukien in Southern China (Morton, 1987).

In Thailand, there are 2 groups of lychee cultivars, the lowland and upland lychee. The lowland cultivars require moderately low temperatures and a period of drought for flowering. The upland cultivars require lower temperatures for flowering and are grown in the northern region. (Anupunt andSukhvibul, 2005)

1.1 The Morphology and Anatomy of Fruit

The lychee tree is handsome, dense, round-topped and slow-growing with smooth, gray, brittle trunk and limbs. It has the leathery, pinnate leaves which are divided into four to eight leaflets. The fruit is covered by a leathery peel skin which is pink-red color and rough in texture. Lychees need full sun, but young trees must be protected from heat, frost and high winds. Fruit shape is oval, heart-shaped or nearly round, 1 to 1-1/2 inches in length. The edible portion is white, translucent, firm and juicy. Lychees taste somewhat like a cross between a grape and a pear. They can be eaten fresh or canned. They can also be made into jellies, preserves, jams, and sauces.

When dried, they are often called "lychee nuts" and resemble raisins in texture, appearance, and taste. (Morton, 1987).

1.2 Hong Huay cultivar

For the northern part of Thailand, there are 3-4 major cultivars; Hong Huay, O-Hia, Gim Cheng, Chakrapat (Emperor lychees). The morphology of Hong Huay cultivar is fast-growing, good yields, round-topped. The body of the tree has slightly brown-grey colour. It has the pinnate leaves. The fruit has oval shaped, pinkish red skin, sweet and sour taste. The weaknesses of this cultivar are big seed, thin skin so it is easy to injured, and has brittle trunk and limbs then the fruit are drop off easily (Hong Huay,2009). In the last three years there were at least 20,000 ton of lychee produced in Chiang Mai Province alone (Table 1.1-1.3)

1.3 Nutritional Facts

The Lychee contains an average of total 72mg of Vitamin C per 200 grams of flesh. This makes lychees a very good source of Vitamin C. On average as little as three lychee fruits would meet a third of an adult's daily recommend Vitamin C requirement. Lychees have high carbohydrate and protein and also high in Copper, Phosphorous, Potassium and the B vitamin, Thiamine but low in Saturated Fat, Cholesterol and Sodium. Most of the energy in a lychee is in the form of carbohydrate.

Table 1.1: Lychee: Growing area, production area, yield and yield per rai 2007

Province	Growing area (Rai)	Production area (Rai)	Yield (Ton)	Yield per rai (Kilogram)
Thailand	**179,284**	**170,783**	**73,858**	**432**
Northern	**156,458**	**148,538**	**63,026**	**424**
North-East	**6,979**	**6,480**	**2,597**	**401**
Central	**15,847**	**15,765**	**8,235**	**522**
Chiangrai*	49,745	48,986	19,986	408
Payoa*	23,665	23,538	9,674	411
Lampang	2,777	2,679	839	313
Chiangmai *	**57,865**	**52,435**	**23,229**	**443**
Maehongsorn	2,333	2,305	1,044	453
Tak	68	68	27	391
Prea	1,001	875	267	305
Naan *	17,414	16,165	7,307	452
Petchaboon	1,590	1,487	653	439
Lai	4,769	4,354	1,955	449
Udornthanee	463	392	151	385
Nongkai	224	224	64	286
Chaiyabhum	521	521	133	255
Nakornratchasima	1,002	989	294	297
Prajinburi	285	285	83	292
Jantaburi	4,395	4,395	2,461	560
Kanjanaburi	984	974	450	462
Ratchaburi	585	569	117	206
Samutsongkram	9,598	9,542	5,124	537

Table 1.2: Lychee: Growing area, production area, yield and yield per rai 2008

Province	Growing area (Rai)	Production area (Rai)	Yield (Ton)	Yield per rai (Kilogram)
Thailand	**166,016**	**159,812**	**53,175**	**333**
Northern	**144,165**	**138,141**	**48,398**	**350**
North-East	**6,214**	**6,109**	**2,012**	**329**
Central	**15,637**	**15,562**	**2,765**	**178**
Chiangrai*	44,273	43,785	14,055	321
Payoa*	23,083	22,956	8,815	384
Lampang	2,604	2,506	589	235
Chiangmai *	**54,625**	**50,768**	**19,089**	**376**
Maehongsorn	2,018	2,018	797	395
Tak	68	68	24	356
Prea	941	815	203	249
Naan *	15,289	14,040	4,338	309
Petchaboon	1,264	1,185	488	412
Lai	4,718	4,636	1,535	331
Udornthanee	30	30	10	325
Nongkai	65	65	17	268
Chaiyabhum	531	521	141	271
Nakornratchasima	870	857	309	361
Prajinburi	30	30	15	502
Jantaburi	4,272	4,272	2,559	599
Kanjanaburi	850	840	26	31
Ratchaburi	634	569	17	29
Samutsongkram	9,851	9,851	148	15

Table 1.3: Lychee: Growing area, production area, yield and yield per rai 2009 (primary observation 30-04-09)

Province	Growing area (Rai)	Production area (Rai)	Yield (Ton)	Yield per rai (Kilogram)
Thailand	**153,620**	**148,562**	**81,748**	**550**
Northern	**131,517**	**126,669**	**71,608**	**565**
North-East	**6,171**	**6,066**	**2,209**	**364**
Central	**15,932**	**15,827**	**7,931**	**501**
Chiangrai*	35,762	35,718	18,252	511
Payoa*	21,699	21,572	14,496	672
Lampang	2,604	2,506	729	291
Chiangmai *	**49,053**	**45,109**	**27,922**	**619**
Maehongsorn	2,018	2,018	894	443
Tak	68	68	28	405
Prea	941	815	226	277
Naan *	18,108	17,678	8,521	482
Petchaboon	1,264	1,185	540	456
Lai	4,695	4,613	1,702	369
Udornthanee	20	20	7	343
Nongkai	65	65	18	282
Chaiyabhum	521	511	149	292
Nakornratchasima	870	857	333	389
Prajinburi	30	30	11	357
Jantaburi	4,272	4,272	2,145	502
Kanjanaburi	850	840	82	98
Ratchaburi	634	569	48	85
Samutsongkram	10,146	10,116	5,645	558

* The data from Office of Agricultural Economics (สำนักงานเศรษฐกิจการเกษตร) 2009

2. Plum

Figure 2: Plum (*P. salicina*, Julie cultivar)

A plum or gage is a stone fruit tree in the genus Rosaceae, subgenus *Prunus*. The subgenus is distinguished from other subgenera (peaches, cherries, etc)
Plum can divide into 2 types; European plum (*Prunus domestica* L.) and Japanese plum (*P. salicina*). Plum that planted in Thailand are usually Japanese plum (Ministry of Agriculture and Cooperative, 2009).

2.1 The Morphology and Anatomy of Fruit

The Plum tree, in the shoots having a terminal bud and the side buds solitary (not clustered), the flowers being grouped 1-5 together on short stems, and the fruit having a groove running down one side, and a smooth stone. Plum fruit is sweet and juicy and it can be eaten fresh or used in jam-making or other recipes. Dried plums are known as prunes. Prunes are also sweet and juicy and contain several antioxidants.

Plums and prunes are known for their laxative effect. This effect has been attributed to various compounds present in the fruits, such as dietary fiber, sorbitol, and isatin. Prunes and prune juice are often used to help regulate the functioning of the digestive system.

2.2 Julie cultivar

This cultivar is usually planted for the fruit processing, not for fresh eating. The fruit has small size (Ø 1-2 cm), round shaped, red skin peel but the flesh is dark yellow. The harvesting period is April to May. (Ministry of Agriculture and Cooperative, 2009)

3. Wine

Wine is a kind of alcoholic beverage made from fermentation of grape juice (grape must) by the enzymes in active yeast(s).The process of fermentation and production should be carefully controlled. Wine, produced from fruit, should be called "fruit wine" and should have the name of that fruit before the word "wine". Wine may also be made from various agricultural raw materials. Wine is a fermented liquor, no distillation in the process of making. Standard wine will contain 8-14% alcohol by volume (Karuwanna, 2005)

3.1 Fruit Wine

A "Fruit Wine" is generally any wine that is fermented from a fruit other than grapes. None of the fruit character comes from the addition of fruit flavors but is the natural product of fruit fermentation. There are many different types of fruit wines, but the some of the most popular include: Red Raspberry, Blackberry, Cherry, Cranberry and Blueberry. These wines are big and intense in their fruit character as it typically takes over ten pounds of fruit to produce one gallon of premium fruit wine. Fermentation techniques vary with the specific winemaker, but often the fermentation is under cold conditions to maximize the retention of fruit character. Well-made fruit wines are a delicate balance between the fruit's natural acidity and residual sugar. If the finished wine is made too sweet, it tends to be cloying on the palette. If it is too dry, it tends to be sharp and astringent. Striking the proper balance is the objective in a carefully crafted fruit wine. Well-made fruit wines come from the finest growing regions for that particular fruit. As in grape wine, optimal fruit quality translates into spectacular fruit wines (Dessert Fortified and Fruit Wines, 2009)

"Fruit Wines" have a multitude of uses. They are often consumed slightly- chilled (55 °F) with a dessert course. For example, Blackberry and Red Raspberry wines are a great accompaniment with dense chocolate desserts as the wine cleanses the palette of the sweet chocolate. Blueberry and Cherry has a similar effect with Cheesecake. Fruit wines may as be used in various baking recipes. Further, they may be used in a number mixed of drink concoctions like a Cranberry Wine Cosmopolitan. Finally, a chilled splash of a Fruit Wine in a glass of sparkling wine makes a wonderful kir before a meal (Dessert Fortified and Fruit Wines, 2009).

4. Chemical composition of wine

There are many kinds of chemical compositions in wine that are important factors in the analysis and the classification for the quality of wine such as TSS, pH, % Alcohol, % TA, % VA and % Reducing sugar

4.1 Total Soluble Solid

The total soluble solid (TSS) in the wine represents not only the sugars but also includes many others soluble substances such as salts, acids and tannins. However, sugar is the compound in greatest quantity for all practical purposes. °Brix is a measure of sugar level (Delfini *et. al.*, 2001). Refractometer is usually measure °Brix of wine. It is fully required range of ambient operating temperature. Temperature is one of the single most important factors influencing accurate Refractometer reading and is one of the largest sources of error in measurement. (MISCO, 2004)

4.2 The Acidity of Wine

The acids in wine are very important components that had direct influences on the color, balance and taste of the wine. Acids that mostly found in wine are Tartaric, Malic, Lactic, Citric, Acetic acid and etc. The acidity in wine is really the sour-factor. If a wine is overly sour or too high in acid it is labeled as tart. If wine has very little acidity it is called flat and dull (Stacy, 2005). In wine tasting, the term "acidity" refers to the fresh, tart and sour attributes of the wine which is evaluated in relation to how well the acidity balances out the sweetness and bitter components of the wine (Robinson, 2006). There are two kinds of acidity usually considered in wine quality determination; total acidity and volatile acidity.

4.2.1 Total Acidity

The total acidity (TA) or known as Titratable Acidity of wine is measurement that assumes all of the acid in grape wine is Tartaric. A high total acidity is 1.0%, too tart too consume. The low total acidity is 0.4% that gave flat taste that sensitive to infection and spoilage by micro-organisms (Pandell, 1999). Total acidity should be 0.6-0.9% as tartaric acid (Karuwanna, 2005). For the fruit that has sour taste, there are ascorbic acid (Vitamin C) and citric acid. So the percent total acidity in fruit wine was calculated by use citric acid instead of tartaric acid.

4.2.2 Volatile Acidity

The Volatile acidity (VA) or vinegar taint is the measurement of volatile acids in wine that are Formic acid, Acetic acid, Butyric acid, Ascorbic acid, and etc. However, in wine analysis the volatile acid are usuallyassumed as acetic acid. The acetic acid in wine can be contributed by many wine spoilage yeasts and bacteria. High volatile acid is an indication of high acetic acid means that there is a high possibility of contamination from acetic bacteria in wine. It can be used as the measurement of spoilage. Acetic acid is responsible for the sour taste of vinegar and it does boil when heated. A % VA of 0.03-0.06% as acetic acid is produced during fermentation and is considered a normal level. The maximum permitted volatile acid in white and red wine in California and France is 0.11 – 0.12% as acetic acid (Pandell, 1999, Karuwanna, 2005)

4.3 Alcohol concentration

Alcohol concentration is recommended to analyze in form of percent alcohol of wine by Ebulliometer. The principle of Ebulliometer is to compare the boiling point of water and wine samples. Standard wine usually contains 8-14% alcohol by volume (Karuwanna, 2005).

4.4 Reducing sugar

The reducing sugar or residual sugar is the level of sugar that remains unfermented in the finished wine. For dry wine may have little residual sugar (0.1 - 0.2 %), semi dry wines usually range from 2-5 % and sweet wines have reducing sugars higher than 5%.

MATERIALS AND METHODS

The following materials are used for the preparation of lychee wine and lychee plum wine.

Materials

1. **Raw material**

   Lychee

   Plum

   Water

   Sucrose syrup

   Yeast

   KMS

   Pineapple juice for starter

2. **Material for fermentation process**

   Plastic tank 100 L as fermenter

   Yeast

   Starter

3. **Material for wine filtration**

   Suction flask

   Whatman filter paper

   Diatom

   Vacuum pump

   Bottle

   Cork

4. Material for chemical measurement

Ebulliometer (Dujardin Salleron)

Glucotest strip (Diabur test 500)

pH meter (HI 98127 HANNA instrument)

Vinometer

Hydro meter

Refractometer

Burette

5. Reagent for chemical measurement

0.1*N* sodium hydroxide

1% phenolphthalein indicator solution

0.025*N* iodine

Methods

1. Study the lychee and plum wine making process

1.1 Starter preparation

The starter was prepared from pineapples. The pineapples were peeled and chopped into small pieces and blended with water (1:1 w/v). Boiled to sterilized and cool it down. Sucrose syrup was added to adjust the sweetness into 10 °Brix. The starter was filled into the 30 liter plastic tank as fermenter. Inoculate with active dry yeast (Lalvin V116 (K1) from Lallamand).The starter was left for 24 – 48 hours to activate.

1.2 Wine preparation

The experiment was done in 4 conditions which are 4 ratios of lychee and plum; lychee only, lychee and plum 1:1, lychee and plum 2:1, and plum only. Peeled and seeded of the lychee and plum, chopped into small pieces and weighed all the pieces and juice into 4 ratio; Lychee 15 Kg for the first ratio (only lychee), lychee 7.5 Kg and plum 7.5 Kg for the second ratio (lychee and plum 1:1), lychee 10 Kg and plum 5 Kg for the third ratio (lychee and plum 2:1). Filled each ratio into the 100 liters plastic tank (steriled with boiled water). Added sucrose syrup to adjust sweetness into 22 °Brix. Add KMS 10 g (150 mg/liter) to kill the unwanted organisms. The fruit juices were leaved for 5-6 hours. Then added starter culture in each tank. Measured °Brix and percent alcohol and record the results. The primary fermentation was about 5-7 days until the °Brix stable. The temperature was about 19-20 °C. The experiment was done in duplicate. During fermentation, the cap (fruit solid mass) needed to be punched down everyday to prevent fruit spoilage and to enhance flavors of fruit in wine. Then racked to separate the fruit body from the must and transferred to new plastic tank (sterilized with boiling water). The secondary fermentation was continued for 5-7 days. Measured °Brix, degree alcohol, pH and recorded the results. Then the wine were racked to new containers and kept for further analysis.

2. Chemical analysis of the lychee and plum wine

2.1 Measure the amount of Alcohol concentration (% alcohol) by using Ebulliometer and Vinometer.

2.2 Measure the amount of reducing sugar in wine by using Glucotest strip.

2.3 Measure the pH value by pH meter.

2.4 Measure the Total soluble solid (°Brix) by using refractometer.

2.5 Measure the amount of Total acidity (%TA) by titration method.

2.6 Measure the amount of Volatile Acidity (%VA) by using distillation machine and titration method

3. Sensory Evaluation by panelists

The questionnaires were set and given to 20 panelists along with the wine samples to evaluate the sensory and the information needed for the future. The questionnaires were asked to complete demographic section including gender, age, income, familiarity of wine and type of wine. In the wine evaluation part, 5-point hedonic scale was used for the panelist preference test based on color, clarity, odor, flavor and overall liking.

4. Statistical analysis

The data obtained from the questionnaires were analyzed by using Randomize Complete Block Design (RCBD). Means were compared by using Duncan's Multiple Range test. The SPSS for window version 17.0 was used for the analysis.

RESULTS AND DISCUSSIONS

This experiment was performed at Baan Obb Tumbon Maung Kaii Amphor Mae Tang Chaing Mai Province (บ้านออบ ต.เมืองก๋าย อ.แม่แตง จังหวัดเชียงใหม่) in the community activity building which is an open area. The TSS of wine samples has been measure and record everyday until the first racking process of all samples. The result of TSS was shown in Figure 3

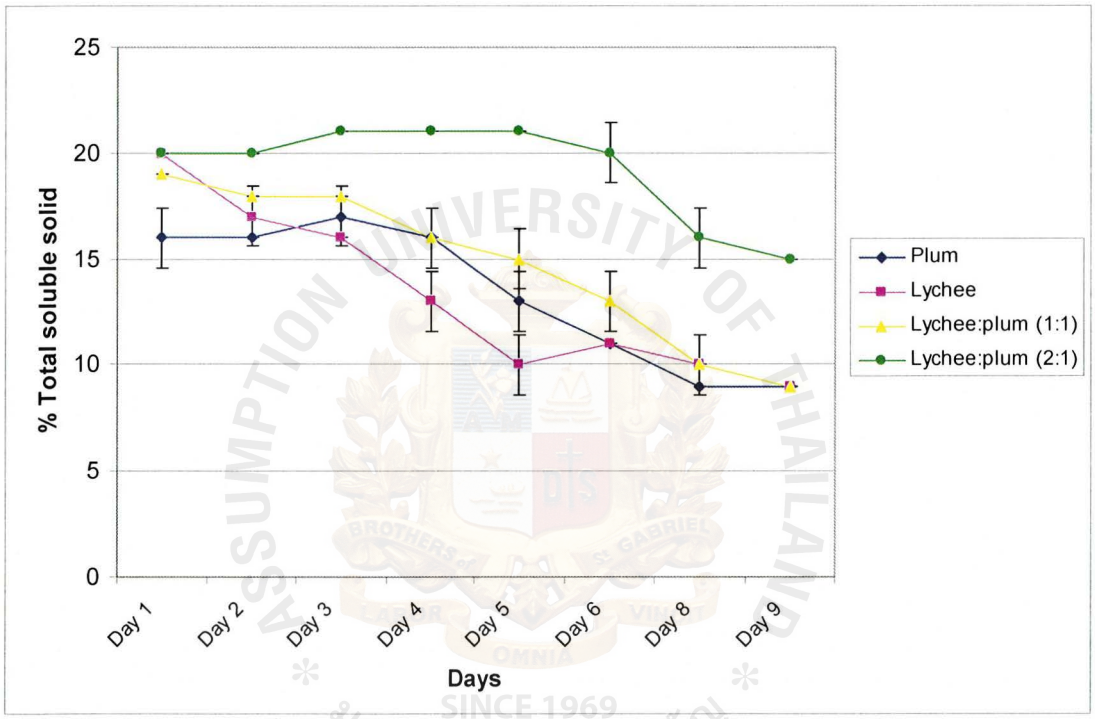

Figure 3: %Total solution solid (w/v) of wine samples during primary fermentation

The rate of TTS utilization (calculated from slope in appendix) of each sample when list from the lowest to the higest value were; Lychee: plum 2:1 = 20.2 %TSS/day. Plum = 20.6%TSS/day. Lychee: plum 1:1 = 20.7%TSS/day. he slope value was calculated to representative the rate of fermention (%total soluble solid per day)Lychee had got the highest rate at 21.5%TSS/day. T.The sample that had highest slope value, in this case was lychee wine, means that sample had high efficiency in fermentation. According to the equation of alcoholic fermentation; yeast convert sugar into alcohol and carbon dioxide gas. So the lychee wine sample was demonstrated the highest fermentation efficiency.

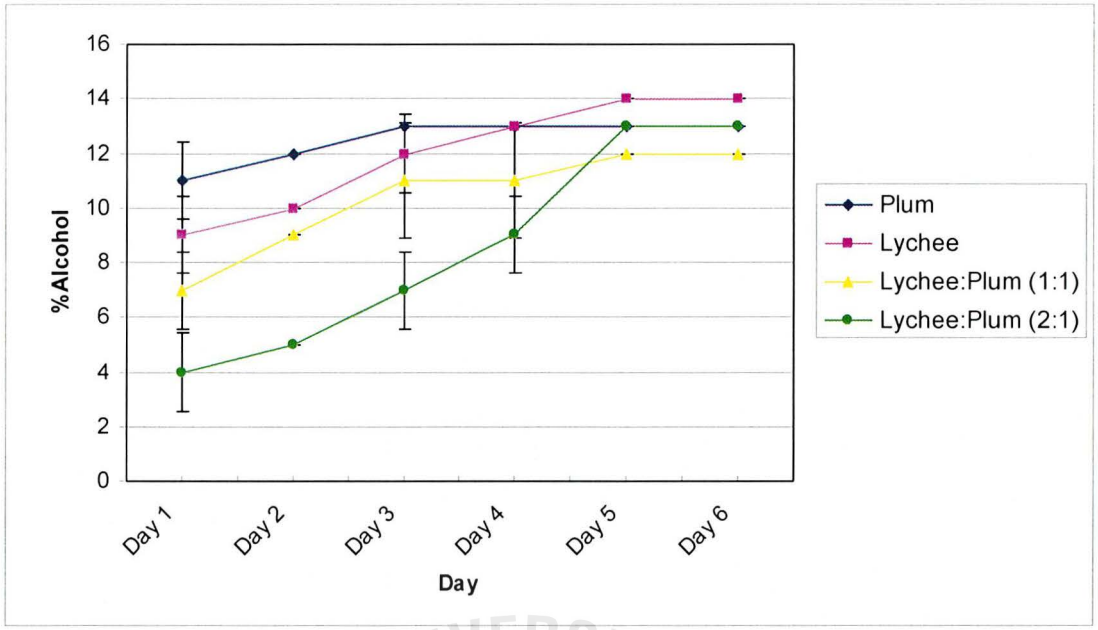

Figure 4: % Alcohol (v/v) of wine sample during the fermentation

The measurements of the % alcohol were done on site by used Vinometer which may have some reading error due to the size of the scale. The data was recorded during the primary fermentation process. It was started from the third day of the fermentation until finished the secondary fermentation (third day of the fermentation was the day that the % alcohol rise up to the detectable level).

From the 3rd day of fermentation, the 2:1 lychee: plum sample had alcohol content about 4 %(v/v) and take 5 days to reach to the maximum level at 13%(v/v). The 1:1 lychee: plum sample had alcohol content about 7% (v/v) and take 5 days to reached to the maximum level at 12%. The lychee sample had alcohol content about 9% (v/v) and take 5 days to the maximum level at 14% (v/v). And the plum sample had alcohol content about 9 % (v/v) and take 2 days to reach to the maximum level at13% (v/v).

When compare with **Figure 9** (in the appendix part), Lychee sample has the highest slope but in this graph (**Figure 4**), it takes about 5 days to reach to the optimum point. The TSS was assumed to the sugar level in wine. This may conclude as the plum sample had quite a high amount of the others soluble substances that the Refractometer also detectable not only the sugars.

When compare fermentation efficiency of all the samples, it must consider the fermentation period due to the amount of the % alcohol. Therefore it may conclude

that plum has highest fermentation efficiency because it used shortest period in fermentation (About 2 days) to reach the the maximum level at13% (v/v).

In this experiment, all of the winemaking process from the start until finish were done at Baan Obb T.Maung Kaii A. Mae Tang Chiang Mai Province (บ้านออบ ต.เมืองก๋าย อ.แม่แตง จ. เชียงใหม่) that quite difficult to control the condition of winemaking because of many troubles such as the lack of the accuracy equipment, the lack of some chemical, the problem about the working area. So, some factors that can be controlled easily in laboratory, were controled with some difficulty in this situation. Some measurement or some analysis cannot be done right there on the site which may resulted in some error in measurement.

Chemical Analysis

The chemical analysis of finished wine were done at the Assumption University Laboratory. Four wine samples with 2 replications each were analyzed for their chemical compositions, including TSS, pH, % Alcohol, % TA, % VA and % Reducing sugar as shown in **Table 2**.

Table 2: Chemical composition of wine samples.

Wine sample	°Brix	pH*	% alcohol (v/v)*	% Reducing sugar (w/v)*	%VA (g/100ml)*	%TA (g/100ml)
Lychee	5.50 ± 0.71 ^{b}	2.95 ± 0.07	12.50 ± 0.71	0.0 ± 0.00	0.04 ± 0.01	0.32 ± 0.00^{b}
Plum	6.50 ± 0.71^{ab}	3.05 ± 0.07	12.00 ± 1.41	0.0 ± 0.00	0.02 ± 0.01	0.66 ± 0.00^{a}
Lychee:Plum (1:1)	8.00 ± 1.41^{a}	2.70 ± 0.00	11.75 ± 1.77	2.50 ± 3.54	0.04 ± 0.02	0.46 ± 0.11^{ab}
Lychee:Plum (2:1)	7.00 ± 0.00 ^{ab}	2.80 ± 0.00	12.00 ± 1.41	2.75 ± 1.41	0.05 ± 0.02	0.42 ± 0.09^{b}

* There were no significant different in the comparison of these chemical properties.

From **Table 2**, the first sample, lychee wine, can be classified as **dry wine** (Reducing sugar was 0.0 %w/v) with the lowest TSS (5.5 °Brix) but the highest alcohol content

(12.5 %v/v) in four samples. Total acidity (TA) of lychee wine was 0.32 g/100ml that lower than regular grape wine. This characteristic could lead to flat taste and the wine will be more susceptible to infection and spoilage by micro-organisms (Pandell, 1999).

The Plum wine was also classified as **dry wine** (Reducing sugar was 0.0 %w/v) with alcohol content 12%(v/v) that was considered as high level of alcohol. This sample had total acidity of 0.66 g/100ml which is in a common range for grape wine. This will resulted in proper taste, not too tart and not too sour. The volatile acidity was 0.02 g/100ml that was the lowest of all four samples but this result was in the normal range.

For the **1:1 Lychee: Plum wine**, this sample was classified as semi sweet wine due to their high reducing sugar content (2.5 %w/v). It has highest TSS (8.00 °Brix) but lowest in alcohol content (11.75% v/v). And % total acidity was too low (0.46 g/100ml) that it was gave flat taste in wine (Pandell, 1999).

For the last sample **2:1 Lychee: Plum wine** was classified as **semi sweet wine** too as thereducing sugar was 2.75 %w/v. The volatile acidity was 0.05 g/100ml that is considered as normal level.

For thetotal soluble solid (TSS), The lychee sample (5.5 °Brix) was significantly different from the 1:1 lychee:plum sample (8.0 °Brix) . The 1:1 lychee: plum sample (8.0 °Brix), the 2:1 lychee: plum sample (7.0 °Brix) and plum sample (6.5 °Brix) had no significant different. While the 2:1 Lychee: plum sample (7.0 °Brix), plum sample (6.5 °Brix) and lychee sample also was no significant different

For total acidity (TA), Plum sample (0.65 g/100ml) had no significant different level of TA from the 1:1 lychee: plum sample (0.46 g/100ml). And the 1:1 lychee: plum sample had no significant different from the 2:1 lychee: plum sample (0.42g/100ml) and plum sample (0.32g/100ml).

Sensory Analysis

The wine samples were tested for consumer acceptance in the local area as describe above in material and method.

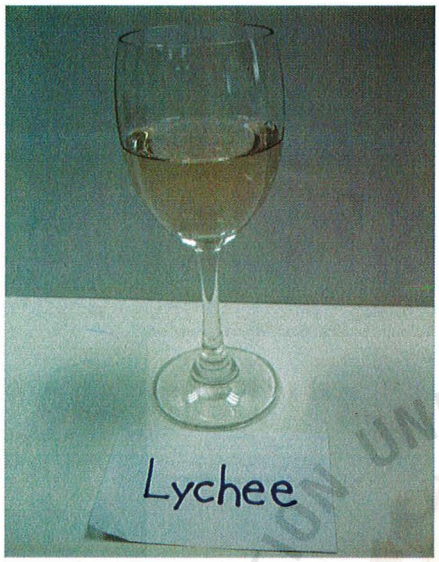

Figure 5: Lychee wine sample

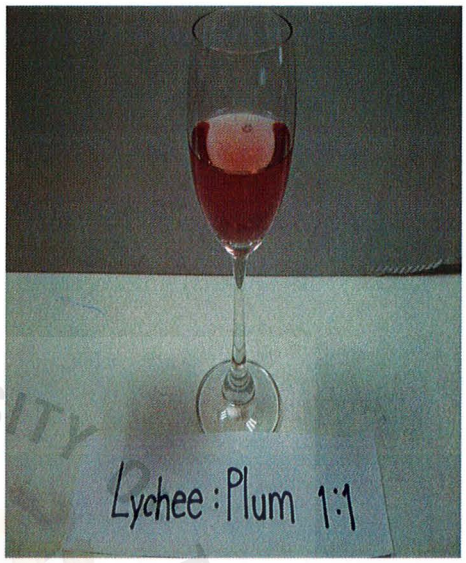

Figure 6: Lychee: Plum 1:1 wine sample

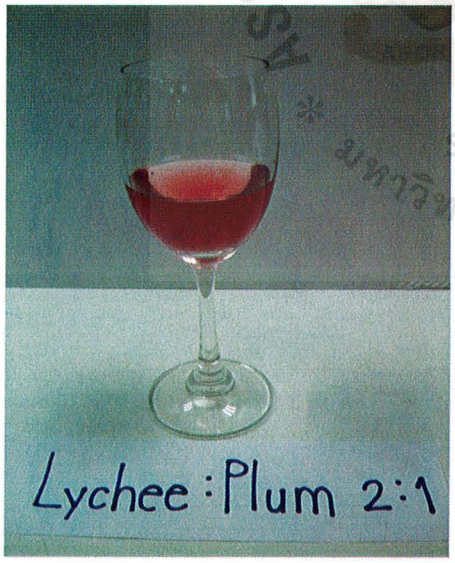

Figure 7: Lychee: Plum 2:1 wine sample

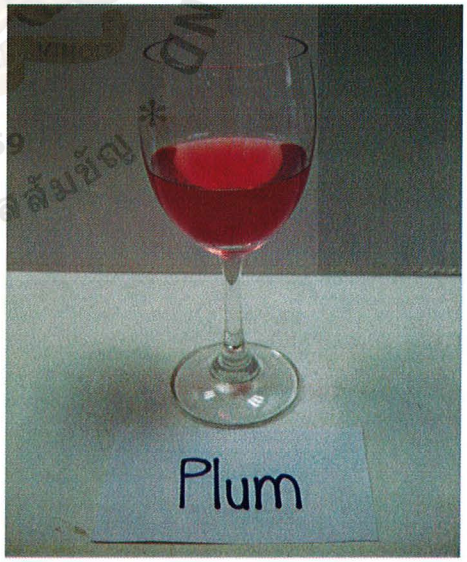

Figure 8: Plum wine sample

From **Figure 5 to 8**, the Lychee sample was the only one that was significantly different from the others in term of colour. It has pale yellow colour and high clearness while the others three had red colour. The lychee: plum 1:1 wine sample had the lightest red colour, the lychee: plum 2:1 wine sample has moderate red colour, and the plum wine sample has the reddest colour. That actually the lychee: plum 1:1 wine sample should had more red colour than the lychee: plum 2:1 wine sample. This case may caused by the ripeness of plum that varied in each sample. So the concentration of the red colour of plum might be error and may give the result like this.

Table 3: Sensory evaluation of wine samples

Wine sample	Color	Clarity	Odor	Flavor	Overall
Lychee	2.15 ± 0.27^{b}	2.55 ± 0.28^{c}	2.25 ± 0.26^{b}	2.05 ± 0.28^{b}	2.40 ± 0.31^{b}
Plum	3.35 ± 0.27^{a}	3.10 ± 0.28^{bc}	3.05 ± 0.26^{a}	3.10 ± 0.28^{a}	3.35 ± 0.31^{a}
Lychee:Plum (1:1)	3.65 ± 0.27^{a}	3.55 ± 0.28^{ab}	3.25 ± 0.26^{a}	3.45 ± 0.28^{a}	3.80 ± 0.31^{a}
Lychee:Plum (2:1)	4.00 ± 0.27^{a}	4.00 ± 0.28^{a}	3.70 ± 0.26^{a}	3.70 ± 0.28^{a}	4.05 ± 0.31^{a}

When analysis for preferred colour, the 2:1 lychee: plum wine was the most satisfaction but it had no significantly different from 1:1 lychee: plum wine sample and plum wine sample. The 1:1 lychee: plum wine sample, the 2:1 lychee: plum wine sample and plum wine sample had red colour while the sample of lychee wine that got the lowest score was quite pale yellow in colour. It could be conclude that the test group preferred the wine in reddish colour.

When considered clarity, the 2:1 lychee: plum wine was the most satisfaction. The 1:1 lychee: plum wine had no significant different with the 2:1 lychee: plum wine and plum wine sample when the plum wine had no significant different with lychee wine and 1:1 lychee: plum wine. From self observation, the lychee wine seem to has the highest clarity but it had got the least satisfaction that it may caused by the colourless of the wine while another 3 samples has less clarity than the lychee wine but they have reddish in colour. This may conclude that the colour had an effect to the taster group of this experiment to have the bias in the consideration of clarity of wine.

When considered odor, plum and the 1:1 lychee: plum wine sample and 2:1 lychee: plum wine sample had no significantly different. They had specific odor that was very attractive from the plum odor. This odor can improved the odor in wine especially when mix with lychee odor, it had citrus smell of lychee and plum's odor that had sweet and fruity smell together. But for the lychee wine sample, it has only lychee odor just like in ordinary lychee juice. So it may not attractive enough when compare with the sample that has been mixed with plum.

When considered flavor, The plum and 1:1 lychee: plum wine sample and 2:1 lychee: plum wine sample had no significant different rate from panelist. The 2:1 lychee: plum wine sample was the most satisfaction when the lychee wine sample, which had least ° Brix (5.5) according to Table 1, was the least satisfaction. So it could be concluded that the test group preferred sweet taste wine. But from Table 1, the 1:1 lychee: plum had the highest ° Brix (8.0) that the taster should prefer this sample more than the 2:1 lychee: plum (if they prefer only sweet taste). So it also concludes that the 2:1 lychee: plum wine sample had more balance in taste that may come from the mixed of the lychee and plum in this ratio (lychee 1: plum 1).

From all attributes, the 2:1 lychee: plum wine sample have got the highest score from the tasters group. So this wine should be accepted by the residents of Baan Obb Chiang Mai.

From the estimation of the production cost for these wine product which assume that the cost of each type of fruit were not different. The production cost was about 10 Baht per 1 bottle (750 ml) (Appendix?) that was considered as very low cost. That means the orchards can set the price to get the profit if they wanted to do the winemaking to be the household industrial. And these wine products may help the local members to save the expense of alcoholic beverage purchase from other sources.

CONCLUSION

There were four ratio wine samples (lychee wine sample, lychee: plum 1:1 wine sample, lychee: plum 2:1 wine sample, plum wine sample) produced in the 100L fermentors at Baan Obb T.Maung Kaii A. Mae Tang Chiang Mai (บ้านออบ ต.เมืองก๋าย อ.แม่แตง จ.เชียงใหม่) during May 2008 to June 2008. The wine made from plum showed a high efficiency in fermentation considered from TSS utilization rate and alcohol content at 0.6%TSS/day and 12% (v/v) respectively. From the sensory evaluation, the 2:1 lychee: plum wine sample had the highest satisfaction. So the most suitable ratio of lychee-plum wine for Baan Obb resident's taste was 2 part lychee (Hong Huay cultivar) per 1 part plum (Julie cultivar).

REFERENCES

1. Anupunt, P., and Sukhvibul, N., 2005.Lychee and longan production in Thailand. [online] Available at: http://www.cababstractsplus.org/abstracts/Abstract.aspx?AcNo=20053145758 [Accessed 05/2009]
2. Delfini,C., and V. F. Joseph, (2001). The microbiological control of wine during storage. In: Wine Microbiology Science and Technology. pp. 309-407.
3. Dessert-Fortified-and-Fruit-Wines, (2009) Fruit Wine.[online] Available at: http://www.wine.com/v6/Fruit-Wines/Dessert-Fortified-and-Fruit-Wines/learnabout.aspx?class=8&varietal=12094 [Accessed 04/2009]
4. Karuwanna, P., (2005) Lab manual BT 3015 Industrial Fermentation. Faculty of Biotechnology, Assumption University, Thailand
5. Ministry of Agriculture and Cooperative : plum [online] Available at: http://www.moac.go.th/builder/bhad/plum.php [Accessed 24/05/2009]
6. MISCO, (2004) Refractometer Temperature Compensation. [online] Available at: http://www.misco.com/compensation.php [Accessed 02/2009]
7. Morton, J. 1987. Lychee. p. 249–259. In: Fruits of warm climates. Julia F. Morton, Miami, FL. [online] Available at: http://www.hort.purdue.edu/newcrop/morton/lychee.html [Accessed 02/2009]
8. Office of Agricultural Economics สำนักงานเศรษฐกิจการเกษตร : official website www.oae.go.th
9. Pandell A. J. (1999). The acidity of wine [online] Available at: http://www.wineperspective.com/the_acidity_of_wine.htm [Accessed 04/2009]
10. Robinson. J., 2006, The Oxford Companion to Wine. Third Edition. Oxford University Press. pg 2-3
11. Stacy Slinkard, (2005). Acidity in Wine [online] Available at: http://wine.about.com/od/vineyardvocab/g/Acidity.htm [Accessed 03/2009]
12. Hong Huay cultivar [online] Available at: http://202.129.0.133/plant/litchi/1.htmI [Accessed 05/2009]

APPENDIX A

Chemical Analysis of some Principle Composition of Wines

1. Total (Titratable) Acidity or TA

Standard

Dry table wine	0.6-0.9%	(as tartaric acid)
Sweet and dessert wine	0.4-0.65%	(as tartaric acid)

Acids found in musts and wines

Tartaric, Malic, Lactic, Citric, Acetic acid and etc. The quantity of acids is usually expressed as percent or g/100 ml of tartaric acid but in France, it is expressed as H_2SO_4 g/l.

Wine should be low in CO_2 in wine, if you want to analyze percent total acidity because $CO_2 + H_2O \longrightarrow H_2CO_3$ which will increase total acidity. So we have to degas wines before analysis total acidity.

Method

1. Titration with 0.1 N NaOH

   Hot water 50 -100 ml + 10 ml of sample (exactly) + 2-3 drop of phenopthalene

   Titrate with 0.1 N NaOH until go to end point (pink color)

Percent total acidity (Citric Acid g/100 ml) = $\frac{V \times N \times 64 \times 100}{1000 \times v}$

If use 0.1 N NaOH

Percent total acidity (Citric Acid g/100 ml) = $V \times 0.064$

Remark: V = volume of used Titrant (NaOH), ml

N = normality of NaOH

v = sample volume, ml

2. Titration with 0.1 N NaOH using pH meter

   The end point should be at pH 8.2

2. pH

It should be measured by pH meter.

Standard pH of wines and musts

Table wine should not exceeding	5.6
Dessert wine should more than	3.8
pH of must for table wine	3.1 – 3.6
pH of must for dessert wine	2.4 – 3.8

* No relationship between the pH and total acidity

3. Volatile Acidity (VA)

Volatile acids in wine are formic acid, acetic acid, butyric acid and etc. But it does not include the steam distillable acid e.g. lactic acid, succinic, sorbic, CO_2, H_2SO_3.

Standard Volatile acid

0.03% as acetic acid. We usually present percent volatile acid as percent acetic acid but in France, percent volatile acid are expressed as g/l of H_2SO_4

Maximum permitted volatile acid

In white and red wine in California and France is 0.11- 0.12% as acetic acid.

Method of analysis

1. Distill mixture of 10 ml of sample and more than 100 ml of water.
2. Collect 100 ml of distillate
3. Boil distillate for 20-30 sec. To thrown away CO_2
4. Add 2-3 drops of phenopthalene and titrate with 0.1 N NaOH
5. End point is pink

$$\text{Percent Volatile Acid as acetic acid g/100 ml} = \frac{V \times N \times 60 \times 100}{1000 \times v}$$

$$= \frac{ml\ of\ titant \times 0.1 \times 60 \times 100}{1000 \times 10}$$

$$= \text{ml of titant} \times 0.06$$

4. Percent Alcohol

Standard for table wine is 8-14% alcohol by volume.

Determination

1. For alcoholic beverage containing less than 15% alcohol by volume should be analyzed by using Ebulliometer.

2. For alcoholic beverage containing more than 15% alcohol by volume should be analyzed by using Alcoholmeter or Alcohol hydrometer at 60°F or 15.56°C.

Therefore it is recommended to analyze percent alcohol of wine by using Ebulliometer.

The principle of Ebulliometer is to compare the boiling point of water and wine sample.

Method of analysis

1. By using Ebulliometer

Find boiling point of water and wine sample. Use chart to find percent alcohol.

2. By using Alcohol hydrometer

If measure at 58°F, you must add (+)

If measure at more than 60°F, you must minus (-)

Example: sample 17% alcohol at 20°C or 78°C

Percent alcohol = 17% alcohol – 1.1

5. Percent reducing sugar

Using the rapid method called "glucotest strip"

(Karuwanna, 2005)

APPENDIX B

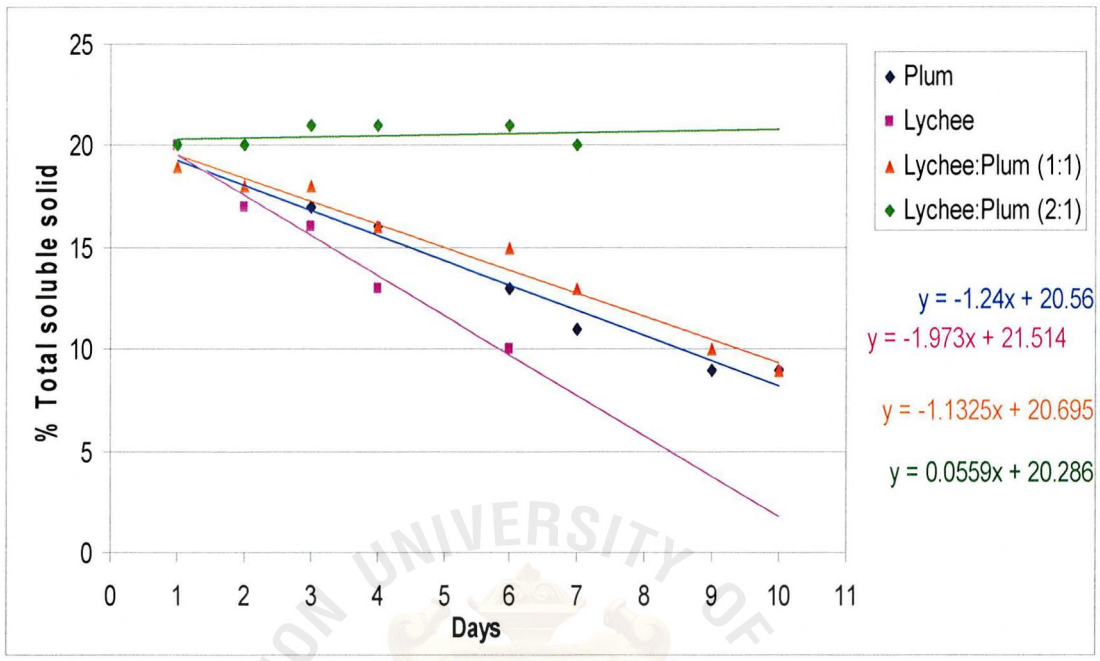

Figure 9: TTS usage rate of wine sample during fermentation process.

This graph was plotted from the constant interval of each line (sample) from the **Figure 3**, which used the slope trend of each sample as a support factor to analyse the fermentation efficiency by %Total solution solid due to times (days). From the equation y = mx + b , b was the slope of the linear graph.

APPENDIX C

Statistical Analysis

Table 4: The descriptive statistics of °Brix of four wine samples

Descriptive Statistics

Dependent Variable:Brix

trt	Mean	Std. Deviation	N
lychee	5.5000	.70711	2
plum	6.5000	.70711	2
lychee:plum (1:1)	8.0000	.00000	2
lychee:plum (2:1)	7.0000	1.41421	2
Total	6.7500	1.16496	8

Table 5: Mean score of °Brix in four wine samples

Brix

Duncan[a,,b]

trt	N	Subset	
		1	2
lychee	2	5.5000	
plum	2	6.5000	6.5000
lychee:plum (2:1)	2	7.0000	7.0000
lychee:plum (1:1)	2		8.0000
Sig.		.164	.164

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .750.

a. Uses Harmonic Mean Sample Size = 2.000.

b. Alpha = .05.

Table 6: The descriptive statistics of pH of four wine samples

Descriptive Statistics

Dependent Variable:pH

trt	Mean	Std. Deviation	N
lychee	2.9500	.07071	2
plum	3.0500	.07071	2
lychee:plum (1:1)	2.7000	.00000	2
lychee:plum (2:1)	2.8000	.00000	2
Total	2.8750	.14880	8

Table 7: Mean score of pH in four wine samples

pH

Duncan[a,,b]

trt	N	Subset 1	Subset 2
lychee:plum (1:1)	2	2.7000	
lychee:plum (2:1)	2	2.8000	
lychee	2		2.9500
plum	2		3.0500
Sig.		.116	.116

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .003.

a. Uses Harmonic Mean Sample Size = 2.000.

b. Alpha = .05.

Table 8: The descriptive statistics of % alcohol of four wine samples

Descriptive Statistics

Dependent Variable:Alcohol

trt	Mean	Std. Deviation	N
lychee	12.5000	.70711	2
plum	12.0000	1.41421	2
lychee:plum (1:1)	11.7500	1.76777	2
lychee:plum (2:1)	12.0000	1.41421	2
Total	12.0625	1.08356	8

Table 9: Mean score of % alcohol in four wine samples

Alcohol

Duncan[a,,b]

trt	N	Subset 1
lychee:plum (1:1)	2	11.7500
plum	2	12.0000
lychee:plum (2:1)	2	12.0000
lychee	2	12.5000
Sig.		.617

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = 1.906.

a. Uses Harmonic Mean Sample Size = 2.000.

b. Alpha = .05.

Table 10: The descriptive statistics of % reducing sugar of four wine samples

Descriptive Statistics

Dependent Variable:Reducing

trt	Mean	Std. Deviation	N
lychee	.0000	.00000	2
plum	.0000	.00000	2
lychee:plum (1:1)	2.5000	3.53553	2
lychee:plum (2:1)	2.7500	3.18198	2
Total	1.3125	2.28250	8

Table 11: Mean score of % reducing sugar in four wine samples

Reducing

Duncan[a,,b]

trt	N	Subset 1
lychee	2	.0000
plum	2	.0000
lychee:plum (1:1)	2	2.5000
lychee:plum (2:1)	2	2.7500
Sig.		.316

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 5.656.

a. Uses Harmonic Mean Sample Size = 2.000.

b. Alpha = .05.

Table 12: The descriptive statistics of volatile acidity of four wine samples

Descriptive Statistics

Dependent Variable:VA

trt	Mean	Std. Deviation	N
lychee	.0360	.00849	2
plum	.0240	.00849	2
lychee:plum (1:1)	.0360	.01697	2
lychee:plum (2:1)	.0480	.01697	2
Total	.0360	.01361	8

Table 13: Mean score of volatile acidity in four wine samples

VA

Duncan[a,,b]

trt	N	Subset 1
plum	2	.0240
lychee	2	.0360
lychee:plum (1:1)	2	.0360
lychee:plum (2:1)	2	.0480
Sig.		.154

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .000.

a. Uses Harmonic Mean Sample Size = 2.000.

b. Alpha = .05.

Table 14: The descriptive statistics of total acidity of four wine samples

Descriptive Statistics

Dependent Variable:TA

trt	Mean	Std. Deviation	N
lychee	.3200	.00000	2
plum	.6555	.00495	2
lychee:plum (1:1)	.4640	.11314	2
lychee:plum (2:1)	.4160	.09051	2
Total	.4639	.14164	8

Table 15: Mean score of total acidity in four wine samples

TA

Duncan[a,,b]

trt	N	Subset 1	Subset 2
lychee	2	.3200	
lychee:plum (2:1)	2	.4160	
lychee:plum (1:1)	2	.4640	.4640
plum	2		.6555
Sig.		.123	.057

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .005.

a. Uses Harmonic Mean Sample Size = 2.000.

b. Alpha = .05.

Table 16: The descriptive statistics of the colour of four wine samples

Descriptive Statistics

Dependent Variable: color

trt	Mean	Std. Deviation	N
Lychee	2.1500	1.34849	20
LP 1:1	3.6500	1.26803	20
LP 2:1	4.0000	.64889	20
Plum	3.3500	1.34849	20
Total	3.2875	1.36125	80

Table 17: Mean score of the colour in four wine samples

color

Duncan[a,b]

		Subse:	
trt	N	1	2
Lychee	20	2.1500	
Plum	20		3.3500
LP 1:1	20		3.6500
LP 2:1	20		4.0000
Sig.		1.000	.107

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 1.416.

a. Uses Harmonic Mean Sample Size = 20.000.

b. Alpha = .05.

Table 18: The descriptive statistics of the clarity of four wine samples

Descriptive Statistics

Dependent Variable: clarity

trt	Mean	Std. Deviation	N
Lychee	2.5500	1.60509	20
LP 1:1	3.5500	1.35627	20
LP 2:1	4.0000	.64889	20
Plum	3.1000	1.16529	20
Total	3.3000	1.33502	80

Table 19: Mean score of the clarity in four wine samples

clarity

Duncan[a,b]

trt	N	Subset 1	2	3
Lychee	20	2.5500		
Plum	20	3.1000	3.1000	
LP 1:1	20		3.5500	3.5500
LP 2:1	20			4.0000
Sig.		.166	.256	.256

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 1.549.

a. Uses Harmonic Mean Sample Size = 20.000.

b. Alpha = .05.

Table 20: The descriptive statistics of the odor of four wine samples

Descriptive Statistics

Dependent Variable: odor

trt	Mean	Std. Deviation	N
Lychee	2.2500	1.29269	20
LP 1:1	3.2500	1.25132	20
LP 2:1	3.7000	.80131	20
Plum	3.0500	1.14593	20
Total	3.0625	1.23600	80

Table 21: Mean score of the odor in four wine samples

odor

Duncan[a,b]

trt	N	Subset 1	2
Lychee	20	2.2500	
Plum	20		3.0500
LP 1:1	20		3.2500
LP 2:1	20		3.7000
Sig.		1.000	.092

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 1.298.

a. Uses Harmonic Mean Sample Size = 20.000.

b. Alpha = .05.

Table 22: The descriptive statistics of the flavor of four wine samples

Tests of Between-Subjects Effects

Dependent Variable: flavor

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	31.650[a]	3	10.550	6.801	.000
Intercept	756.450	1	756.450	487.618	.000
trt	31.650	3	10.550	6.801	.000
Error	117.900	76	1.551		
Total	906.000	80			
Corrected Total	149.550	79			

a. R Squared = .212 (Adjusted R Squared = .181)

Table 23: Mean score of the flavor in four wine samples

flavor

Duncan[a,b]

trt	N	Subset 1	Subset 2
Lychee	20	2.0500	
Plum	20		3.1000
LP 1:1	20		3.4500
LP 2:1	20		3.7000
Sig.		1.000	.155

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 1.551.

a. Uses Harmonic Mean Sample Size = 20.000.

b. Alpha = .05.

Table 24: The descriptive statistics of the overall liking of four wine samples

Descriptive Statistics

Dependent Variable: overall

trt	Mean	Std. Deviation	N
Lychee	2.4000	1.72901	20
LP 1:1	3.8000	1.43637	20
LP 2:1	4.0500	.82558	20
Plum	3.3500	1.42441	20
Total	3.4000	1.50611	80

Table 25: Mean score of the overall liking in four wine samples

overall

Duncan[a,b]

trt	N	Subset 1	Subset 2
Lychee	20	2.4000	
Plum	20		3.3500
LP 1:1	20		3.8000
LP 2:1	20		4.0500
Sig.		1.000	.138

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 1.941.

a. Uses Harmonic Mean Sample Size = 20.000.

b. Alpha = .05.

APPENDIX D

Questionnaire

แบบสอบถาม เรื่อง ความพอใจของผู้บริโภคเรื่องไวน์ที่ผลิตจากลิ้นจี่และพลัม

ส่วนที่ 1 ข้อมูลส่วนตัว

1. เพศ ☐ ชาย ☐ หญิง
2. อายุ _____ ปี
3. รายได้ต่อเดือน
   - ☐ น้อยกว่า 5,000 บาท
   - ☐ 5,000 -10,000 บาท
   - ☐ 10,001 -- 15,000 บาท
   - ☐ ตั้งแต่ 15,001 บาท ขึ้นไป
4. คุณเคยดื่มไวน์หรือไม่ (ถ้าไม่เคยข้ามไปทำส่วนที่ 2)
   - ☐ เคย
   - ☐ ไม่เคย
5. คุณเคยดื่มไวน์ชิดอื่นดังต่อไปนี้หรือไม่ (ตอบได้มากกว่า 1 ชนิด)
   - ☐ องุ่นแดง
   - ☐ องุ่นขาว
   - ☐ ผลไม้ (โปรดระบุ_____)
   - ☐ อื่นๆ (โปรดระบุ_____)
6. ประเภทของไวน์ที่คุณดื่มเป็นไวน์ประเภทอะไร
   - ☐ ไวน์ผลิตในประเทศ
   - ☐ ไวน์ผลิตในต่างประเทศ
7. คุณดื่มไวน์ในโอกาสใดบ้าง
   - ☐ งานเลี้ยง งานสังสรรค์
   - ☐ ใช้เป็นยารักษาโรค
   - ☐ เพื่องานวิจัย
   - ☐ ประกวดแข่งขัน
   - ☐ อื่นๆ (โปรดระบุ_____)
8. คณดื่มไวน์บ่อยแค่ไหน
   - ☐ 1-2 ครั้งต่อสัปดาห์
   - ☐ 3-4 ครั้งต่อสัปดาห์
   - ☐ ทุกวัน
   - ☐ นานๆ ครั้ง (โปรดระบุ_____)
9. โดยปกติคุณซื้อไวน์ที่ไหน
   - ☐ ห้างสรรพสินค้า
   - ☐ ร้านสะดวกซื้อ
   - ☐ ร้านค้าปลอดภาษี
   - ☐ อื่นๆ (โปรดระบุ_____)

ส่วนที่ 2 การยอมรับของผู้บริโภค

ผลิตภัณฑ์ : ไวน์ที่ผลิตจากลิ้นจี่และพลัม

คำชี้แจง 1. กรุณากลั้วปากด้วยน้ำเปล่าก่อนการชิมทุกชนิดตัวอย่าง

2. ให้คะแนนความพอใจเรียงจากน้อยไปมาก

ระดับคะแนน 1 = ไม่ชอบเลย

2 = ไม่ชอบปานกลาง

3 = เฉยๆ

4 = ชอบปานกลาง

5 = ชอบมาก

คุณลักษณะ	ไวน์ลิ้นจี่	ไวน์ลิ้นจี่และพลัม (1:1)	ไวน์ลิ้นจี่และพลัม (2:1)	ไวน์พลัม
สี				
ความใส				
กลิ่นผลไม้				
รสสัมผัส				
ความพอใจโดยรวม				

ความเห็นอื่นๆ

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APPENDIX E

Cost Analysis

The cost of production

In the fermentation process were used;

raw fruit (lychee or plum)	≈	3	Baht per kg
sugar	≈	24	Baht per kg
diatoms	≈	50	Baht per kg
yeast	≈	20	Baht

Each sample was used (calculate for only 1 fermenter 100 liter) raw fruit (lychee or plum) 15 kg , sugars(include sucrose syrup) 20 kg, diatom 1 kg and dry yeast

$$3(15) + 24(20) + 50(1) + 20 = 590 \text{ Baht}$$

From the must 60 liters $\Rightarrow$ wine 45 liters or 45000 ml

So 750 ml $\Rightarrow$ 10 Baht