THE PRODUCTION OF FIG BANANA WINE

By

Ms. Sutatip Ovartvoraporn

A special problem submitted to the faculty of biotechnology, Assumption University, in part fulfillment of the requirements for the bachelor degree of science in Biotechnology.

August 2003

SENIOR PROJECT

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MISS SUTATIP OVARTVORAPORN I.D 4218716

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By : Ms. Sutatip Ovartvoraporn
Advisor : Dr. churdchai Cheowterakul
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C. Cheowterakul Advisor

(Dr. Churdchai Cheowterakul)

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Ms. Sutatip Ovartvoraporn
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ABSTRACT

The objective of this project is to study the process of banana fig (กล้วยตาก) wine production. Various amount of banana fig was used in the wine making formulation. Difference types of sugars, for example sucrose syrup and honey, are experiment to provide the diversity of the taste. The quality of the finish products were studied by measuring the acceptability of the attributes of color, clarity, aroma, body, flavor, balance, finished, and overall acceptability by sensory evaluation of 15 trained panelist.

From the result of chemical analysis study, fermentation was finished within 12 days at room temperature. The optimum ratio of the banana fig to water is 1:3 banana figs to water in both in sample added with syrup and honey to enhance the wine quality. The final °Brix of both sample are around 7.4-8.2. The pH is 4.6 and the acidity is lower than 0.383g%. Alcoholic content are 11 and 12% respectively.

From the study of sensory evaluation, the ratio of 1:3 banana fig to water wine fermented added with sucrose syrup produce the most preferable wine according to the panelist.

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INTRODUCTION

The history of wine had started long time ago; wine culture may have commenced in the Far East, in Mesopotamia, or in Egypt. At that time, wine is simultaneously fermented and kept in the animal stomach for the ease of the consumer. In the old time, wine is only for the well being class of people that was used in the ceremony or celebration. However at present, wine drinking has become popular among the middle-class people. Nowadays wine is not only for celebration but it also drinking as a tonic for the better health. And wine is also very popular in Thailand. Many people drink wine for pleasure and health. But because the volume and quality of Thai wine still considerably low and the local brand names have not yet to be recognized in the wine market therefore many wine drinker prefer more of the imported wine. The majority of Thai wines are produced from domestic fruit. The quality of Thai fruit wine still at the preliminary stage and has yet to be developing. Thailand has a large variety of Thai fruits which have a great potential to be use as raw material for the production of Thai fruit wine. Therefore the Thai government had put in an immensely afford to promote this product. A few examples of the local Thai fruit that can be used favorite as a raw material for wine production are; Roselle, pineapple, lychee, Indian mulberry, mangosteen and banana. Especially in banana, Thailand has a large variety of banana which can be used to make different kind of banana wine.

The above reason had attracted my interest to study and find out the method of how to use banana fig (one of the product of banana preservation) to develop and product wine that will be accepted to consume. The reason I choose banana fig instead of fresh banana because fresh banana has a limited storage shelf life. And banana fig contributes a better after taste favor than fresh banana.

OBJECTIVE

The objectives of this study are:

1. To study the process of the banana fig wine making under the difference condition.
2. To study the chemical property of the banana fig wine.
3. To study the acceptant of the consumer to these fig banana wine.

LITERATURE REVIEW

1. Wine

1.1 What is wine

Wine is one of the alcoholic beverages that are made by fermented grape fruit juice. Wine is produced in temperate zones worldwide. The best grapes for wine making are a product of thin, flinty soil. Traditionally, grapes have been grown in vineyards bordering on rivers, which early in the history of the industry, in such regions as the Rhine, and Loire valleys of Europe, provided convenient transport. (Ron S. Jackson, 1994)

1.2 Wine classification

There are three types of wine; white wine, red wine and rose. Red wines are made from dark red grapes, the skins of which are allowed to remain in contact with the fermenting juice for a period of two days to three weeks, depending on the character and depth of color desired. White wines may be made from "white" (that is, green) grapes or dark grapes, but in the latter case the grape skins are pressed into juice and the skin do not come into contact with juice during fermentation. Rose wines are the products of dark grapes; their skins remain in contact with the juice until they have turned into pale pink color.

Wines may be grouped according to the sweetness, alcohol content, carbon dioxide level, color, grape variety used, fermentation, maturation process involved, or geographic origin. For taxation purpose, wines often are divided into three basic categories, namely, still wines, sparkling wines, and fortified wines; the latter two typically are taxed at a higher rate. This division recognizes signification and still in use.

1.2.1 Still table wine

Table wines, also called still or natural wines are consumed primarily as complements to food. As most wines fall into the category of still table wines, it requires the most complex classification system. Table wines are further classified by color, as red, white, or rose (pink); and by character, as sweet or dry.

Table 1: composition of grapes and natural table wine (Richard P. Vine, 1997)

Component compound	Approx. % in grapes	Approx. % in wine
Water	75.0	86.0
Sugar (fructose, glucose, with minor levels of sucrose)	22.0	0.3
Alcohols (ethanol, with trace levels of higher alcohols)	0.1	11.2
Organic acids (tartaric, malic, lactic)	0.9	0.6
Minerals (potassium, calcium, with minor levels of sodium, magnesium, iron, etc.)	0.5	0.5
Phenol (flavonoids and nonflavonoids)	0.3	0.3
Nitrogenous compounds (protein, amino acids, humin, amides, ammonia, etc.)	0.2	0.1
Total	99.0	99.0

1.2.2 Sparkling wines

Sparkling wines often are classified by the method used to achieve the high carbon dioxide content. Sparkling wines, for

example champagne, distinguishable by their effervescence, are drunk for the most part on festive occasions. The three primary techniques are the traditional (champagne), transfer, and bulk (charmat) methods. (Ron S. Jackson, 1994)

1.2.3 Fortified wines (Dessert and Appetizer Wines)

Fortified wines, such as sherry or vermouth, are most commonly drunk before or after meals and are also frequently used in cooking. These wines are termed fortified because their alcoholic and sugar content are increased and their fermentation arrested by the controlled addition of a more potent liquor, usually a grape brandy, during the wine-making process; this results in an alcoholic content of 15 to 22 percent by volume, against 9 to 14 percent for most table wines.

1.3 Variety of vines

There many type of grape which is used to produce wine such as *Vitis vinifera*, *Vitis Labrusca*, and *Vitis Riparia*. *Vitis vinifera* is cultivated around the world today as the true noble wine grape. The *Vitis Riparia* is constituted as fox grape. The species *Vitis vinifera* is referred to as the "post-oak" or "frost" grape. It is widely adapted to almost all of temperate North America. (Richard P. Vine, 1997)

1.4 Wine quality

The quality of wine can be identified as chemical property and physical property. (Ron S. Jackson, 1994)

1.4.1 Chemical property of wine

The chemical property of wine will be measure by using the value of pH, amount of reducing sugar and percentage of alcohol. (Ron S. Jackson, 1994)

1.4.1.1 alcoholic content

Wines vary dramatically in their alcoholic content. By law in the U.S., at least, "table wines" may contain anywhere from 7 and 14 percent alcohol, with most falling in the range of 11 to 14 percent. But some wines are as light as 5 percent alcohol or less (in term of technically, it can't be labeled as "wine"), while some light, sweet German wines may top out at 8 or 9 percent. At the high end, some of the biggest New World Chardonnays and Zinfandels ferment out naturally at 15 percent or above, while powerful brandy-fortified wines like Port and some Sherries can reach 18 to 22 percent. (Ron S. Jackson, 1994)

1.4.1.2 amount of reducing sugar content

Grape juice that has been allowed to ferment all, or the overwhelming majority, of the fermentable sugars in the juice is termed a dry wine. It is said to have "fermented to dryness" and contains less than 10 grams per liter of sugar. Wines with significant amounts of fermentable sugars left, greater than 10 grams per liter, have a sweet taste and are termed sweet wines. (Ron S. Jackson, 1994)

1.4.1.3 pH value

pH is another important aspect of acidity. Wine, in generally will contain pH not more than 3-4. Wines very consideration in pH, with pH values below 3.1 being sensed as sour while those above 3.7 tastes “flat”. White wines are commonly preferred at the lower end of the pH range, while red wines are frequently favored in the mid range. (Ron S. Jackson, 1994)

Table 2: standard quality of wine

Attributes	Legal limit (table wine)
Alcohol	7-13.5% (v/v)
SO_2	<10 ppm *US limit
Total acidity	0.4-1.0% (4 g/L-10 g/L)
Volatile acid	1.2 g/L
pH	3-4
Reducing sugar	0.2-3% (2-30 gm/L)

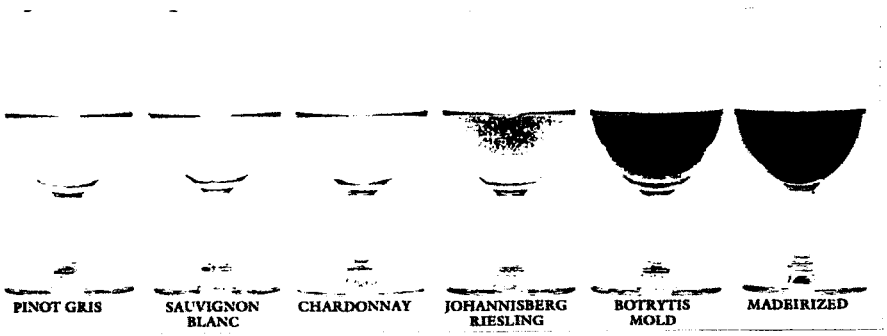
1.4.2 Physical property

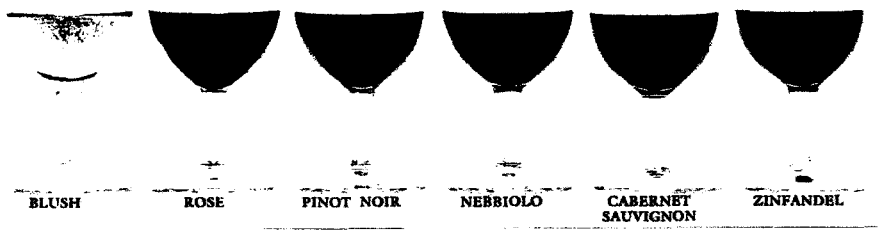
The physical property of wine will be classified by measuring the color, clarity, tear, and viscosity of the wine product. (Ron S. Jackson, 1994)

1.4.2.1 color

The visual characteristic of wine depends on how its chemical and particulate nature transmits, absorb, and reflect visible radiation. The color of wine can be measure by using the spectrophotometer or human eyes. The first concern for color is hue, or an identity of specific color value such as "straw gold" or "ruby red". This is follow by a judgment on color intensity, the quality of hue present in the wine. Color evaluations are best made against a stark white background. By looking downward through the glass, one can perceive variances in both hue and intensity as stationary light passes through difference depths of the wine. The wine should have the same color hue throughout but intensity will seem denser in the center of the glass where the wine is deeper. Young dry white wines generally range from nearly colorless to pale straw colored. A more obvious yellow tint is often suspected, unless associated with maturation in oak cooperage. Sweet white wines may vary from a pale straw color to yellow-gold. Rose wines are expected to be pale pink, with out shades of blue. Red wines vary from deep purple to pale tawny red. Initially most red wines have a purplish-red hue. (Ron S. Jackson, 1994)

Picture 1: color of white wine (Richard P. Vine, 1997)





Picture 2: color of red wine (Richard P. Vine, 1997)

Table 3: the color of difference wine type (Richard P. Vine, 1997)

Wine type	Color hue	Color intensity
Dry Vermouth	pale celery	extremely light
Sauvignon Blanc	pale straw	very light
Chardonnay	straw	light
Sauternes	golden	moderate
Blush	pink	light
Anjou Rose	rose	moderate
Pinot Noir	crimson red	light
Merlot	scarlet red	moderate
Cabernet Sauvignon	garnet red	dark
Port	ruby red	dense
Tawny Port	amber red	moderate
Oloroso Sherry	amber	dark

1.4.2.2 clarity

The common procedure in evaluating clarity is to hold the wineglass by the stem or base so that a constant light source behind the glass can filter through the wine. Wine with perfect clarity has no trace of suspended particles or lint. The four generally accepted echelons of wine clarity are:

- Brilliant
- Clear
- Hazy
- Cloudy

1.4.2.3 tear

Tear is another phenomenon often given considerable attention in the popular wine press. Tears from after the wine has been swirled and a film of wine coats the inner surface of the glass. Tears continue to develop as long as alcohol evaporation draws sufficient wine up the film to counteract the action of the gravity in pulling the film down. (Ron S. Jackson, 1994)

1.4.2.4 viscosity

Although viscosity is often mentioned in the popular wine literature, perceptible increases usually occur only when sugar and/or alcohol contents are high, or in cases of wine showing ripeness. The glycerol content apparently needs to be relatively high to have a detectable sensory influence on viscosity. (Ron S. Jackson, 1994)

1.5 Yeasts

Yeasts are classified taxonomically among the fungi. Yeasts will be in groups; the yeastlike growth habit has evolved independently in at least three major fungal taxa. The important species of yeast in wine making is *saccharomyces cerevisiae.* Under the proper condition, it will be convert sugar to alcohol and carbon dioxide in wine. *Saccharomyces cerevisiae* is amazingly suited to its role as the predominant fermenter of grape must. It is remarkably tolerant to high sugar, ethanol, and sulfer dioxide concentration.and it typically metabolizes the fermentable sugars in must completely. Because *saccharomyces cerevisiae* has a low respiratory potential, it also grows and ferments rapidly at the low pH values that typify grape must.

1.6 Fermentation process

Winemaking can be divided into four phases:

- Harvesting fruit and ensuring it is in optimum condition.
- Fermenting the grapes into wine.
- Clarification and stabilizing the wine.

- Ageing.

The method of wine making and the grape raw material will be depending on the type of wine; white or red wine.

1.6.1 White wine process

After harvest, grapes are removed from the bunch stem and gently pushed through rollers to split the berries. After that put it through the crusher or destemmer, the must (a combination of juice, skins and seeds) is pumped to the press to separate the juice from the skins and discarded the skins, stems and seeds under cold temperature. The cold juice is allowed to settle and then clear juice is decanted off the residue before it is fermented.

Winemakers manage the fermentation by controlling parameters such as temperature and the pressing technique. Most whites are fermented at 63–72°F. Fermentation takes place in tanks, usually large stainless steel tanks. Cold stabilization of a wine may also take place here. Tanks are fitted with a cooling jacket through which coolant is pumped to export heat from the ferment. Vats or barrels constructed from oak can also be used to ferment wine. The wine will be clarified by fining, racking and filtration. Wine is stabilized by removing the excessive protein and potassium hydrogen tartrate out to prevent them from precipitating out of the wine later. After this the wine will be stable and the winemaker can be reasonably confident the wine will remain clear and bright after bottling.

As the wine ages it develops "bouquet". Wine acids react with alcohols to produce volatile esters and during bulk storage oxidation slowly changes many wine ingredients. After the wine is bottled, oxygen is no longer available, and a different type of ageing begins to take place.

1.6.2 Red wine process

Red wine grapes have colorless juice. The red color is in the grape skins and winemakers leave the juice in contact with the skins for a time to extract the color.

After harvest, grapes are removed from the bunch stem and gently pushed through rollers to split the berries then put it through the crusher or destemmer the must, a combination of juice, skins and seeds is fermented for several days.

Winemakers manage the fermentation by controlling parameters such as temperature and the pressing technique. Fermentation takes place in tanks, usually large stainless steel tanks. After finish the process, the fermented must is then pumped to the press to separate the juice from the skins. Wine will be clarify by fining, racking and filtration. It is stabilized by removing excessive protein and potassium hydrogen tartrate out. These materials must be removed to prevent them from precipitating out of the wine later.

The wine is then aged. Red wine can then spend anything from a few weeks to a few years in either stainless steel or oak where it is racked and fined several times prior to bottling. As the wine ages it develops "bouquet". Wine acids react with alcohols to produce volatile esters and during bulk storage oxidation slowly changes many wine ingredients. After the wine is bottled, oxygen is no longer available, and a different type of ageing begins to take place. Some premium red wines can spend several additional years in bottle before being released.

- In case of the sparkling wine; the process is as same as the red and white wine but adding the carbon dioxide gas as a special to make it carbonate and sparkling while open.

1.7 Wine spoilage

With modern winemaking technology, there are probably fewer bottles of faulty wine around than ever before. However, it will occur occasionally. Below are some of the most common faults. (Bruce, Kenneth, Barry, and Fred, 1995)

1.7.1 Cork- relate problem

Unfortunately, corks are sometimes faulty. Either the cork is diseased or the chemical treatments used in cork processing have been wrongly used. Corked wine has a musty, mushroomy smell. This can vary from a faint trace to a real stink. The wine will often appear dull and lifeless, with a faintly gray hue. The taste will also be musty. Often the longer a corked wine has been open the more detectable the smell is, so in a restaurant it is still worth complaining. (Bruce, Kenneth, Barry, and Fred, 1995)

Corked wine has nothing to do with stray bits of cork floating in a glass. This is quite harmless and is caused by the corkscrew cutting off pieces when the bottle is opened. The cork can easily be fished out of the glass. (Bruce, Kenneth, Barry, and Fred, 1995)

1.7.2 Oxidized

Too much oxygen kills wine but small quantities allow it to age and mature. White wines are particularly prone to oxidation, although modern technology has lessened this problem greatly. Sherry is an example of a wine that has been allowed to oxidize; so white wines, which have a sherry-like smell, may well be oxidized. They are also likely to be markedly yellow in color. (Bruce, Kenneth, Barry, and Fred, 1995)

1.7.3 Too much sulfur

Ninety-nine percent of wine has some sulfur in it. Sulfur dioxide is a vinous antiseptic, used to protect firstly the grapes and then the wine from harmful bacteria. It is also used to stop fermentation by killing off the yeasts. This is why too much sulfur can be particularly prevalent in sweet wine, as the winemaker will have used it to stop the fermentation before all the sugar has been converted into alcohol. (Bruce, Kenneth, Barry, and Fred, 1995)

Producers are now trying to use as little sulfur as possible and certainly sulfur levels in wine are much lower than they used to be. But it will still come across bottles with excessive sulfur. The wine will smell sulfury, eggy, and it will have a sour taste. Drinking wine with too much sulfur causes headaches. (Bruce, Kenneth, Barry, and Fred, 1995)

1.7.4 Unclean wine

Very occasionally bottles of wine have bits of dirt floating in them. This is probably because the bottle wasn't properly clean when it was filled. (Bruce, Kenneth, Barry, and Fred, 1995)

1.8 Wine storage

Red wine will generally develop and improve when cellared in the bottle, depending on the style of the wine and the quality of the particular vintage. Most white wines are best enjoyed when relatively young. (Jim Budd, 1996)

Cellaring allows the wine to mature, though you don't need an actual cellar to store wine. Wine is best stored somewhere cool, dark, airy and free from vibration and dampness. The single most important factor is temperature stability. Wine stored when the temperature varies gradually with the seasons is better off than wine stored in a room that rapidly changes temperatures. The ideal cellar temperature is about 58 degrees Fahrenheit.

Warm conditions will accelerate the development of your wines, possibly reducing their flavor. (Jim Budd, 1996)

A simple wooden or metal racking system keeps wines well ventilated and provides easy single-bottle access. Bottles should be stored on their sides, ideally with the necks sloping slightly upwards so that the cork remains wet, the bubble of air is in the shoulder, and any sediment will collect at the bottom of the bottle. Also, store wine with the label facing up, or use written neck tags so that you need not disturb a wine to identify it. (Jim Budd, 1996)

Picture 3: storage room (Jim Budd, 1996)

1.9 Sensory evaluation

The sensory evaluation is a "scientific discipline used to evoke measure, analyze, and interpret reactions to the characteristics of foods and materials as they are perceived by the sense of sight, smell, taste, touch, and hearing". Wine assessment and sensory analysis cover various aspects of wine evaluation. They may

include preference determination, assessment of individual properties in comparative tasting, or the development of flavor profile for particular varietals and/or regional wines. The sensory should be done under the standard condition and the selection of sensory evaluation method is determined based on the type of information that is needed. (Ron S. Jackson, 1994)

1.9.1 Conditions for sensory analysis

1.9.1.1 tasting room

In tasting room, the lighting source is considered to be natural north-lighting, white light source probably is acceptable. Tasting rooms need to be adequately air-conditioned, both for taster comfort and to limit the development of a background odor. Each tasting station should be physically isolated to limit taster interaction. Silence also limits between taster influence and facilitates concentration. Where tasters cannot be physically separated, the order of wine presentation may be varied among the tasters to negate the influence of taster interaction.

1.9.1.2 controls for sample preparation and presentation

The preparation and presentation of the samples must be uniformly controlled to avoid any biasing of response during evaluation. The samples are served in a standardized fashion, considering serving temperature, serving size. The panelist must have an adequate sample size to complete the evaluation required. And samples must be coded to eliminate bias. A three-digit code, chosen at random, is assigned to each product and used to identify the product sample to the panelist.

1.9.2 Sensory panelists

Control of human aspect of sensory evaluation is one of the more difficult factors of sensory evaluation. This may be accomplished best by carefully selecting the people that will be participating in the test.

1.9.2.1 panelist selection

Panelists are selected based on the type of test needed. Consumer panelists or experienced/trained panelists are used to answer different sensory questions.

1.9.2.2 number of panelists

The number of panelists is dependent on the type of testing required. To obtain a good understanding of consumer opinions, a minimum of 50 panelists are needed and more are desirable. Tests for difference between products may be completed with as few as 10 to 12 experienced panelists; however, differences may not be observed with such a small number.

1.9.2.3 panelist screening

Panelists are selected for participation on an experienced or trained panel by initially screening for motivation to perform the test and ability to concentrate and communicate. Screening is completed to determine abilities to identify differences using dilute solutions that may represent.

1.9.2.4 panelist orientation

Before beginning any discriminative sensory analysis, panelists must receive some instruction, which may be as brief as an explanation of scorecard and familiarization with standardized testing procedures.

1.9.2.5 panelist motivation

Panelist must be motivated to contribute time and effort required for frequent testing situations.

1.9.2.6 timing of panel

Training and testing time periods should be scheduled when the panelists will be most sensitive to product characteristics and have the attention to focus on the task at hand.

1.9.3 Method of sensory evaluation

Sensory evaluation methods may be divided into two broad classes: affective and analytical methods. Affective methods use consumer panels or untrained panelists to answer the question. Affective method requires much larger panel size than do analytical methods in order to have greater confidence about the interpretation of the result. The most common analytical methods of sensory evaluation used in the wine industry are discrimination and descriptive methods. Discrimination tests can be used to determine if products are different, if a given wine characteristic is difference among samples, or if one product has more of selected characteristic than another. Experienced panelists can complete discrimination. Descriptive methods are used to provide more comprehensive profiles of a product by asking panelists to identify the different characteristics within the product and quantify characteristic. Trained panelists must be used for descriptive methods.

1.10 Wine testing

There are three logical and consecutive stages to wine tasting: looking at the color of the wine, smelling the aroma, and, finally, the taste. When tasting, it is easiest to hold the stem of the glass. (Jim Budd, 1996)

1.10.1 Color

Look at the color. It will obviously tell you are drinking red or white. A brick-colored red is likely to be several years old. A white wine that almost colorless is likely to be young. A golden colored white may be sweet or it may have been fermented and aged in oak, and it might be several years old.

Picture 4: color tasting (Jim Budd, 1996)

A very young dry white that is strangely yellow may be spoiled and oxidized. (Jim Budd, 1996)

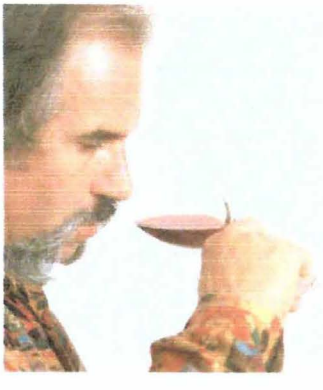
1.10.2 Smell and aroma

Picture 5: smell and body tasting (Jim Budd, 1996)

Raise the glass to your nose and sniff; don't agitate the glass. Now, holding the stem, rotate the glass so that the wine coats the glass. The larger area of glasses coated releases more aroma. Right-handed people naturally rotate their glass in a counterclockwise direction, whereas left-handers will shoot white wine in all direction. The smell of wine should be detected as the powerful of the aroma, the fruit smell (fresh or cooked), grassy or a smell of straw or hay or mineral aroma. Sometimes wine can be smell of chocolate, tobacco, liquorices, coffee, mushrooms, and rotting vegetable.

Wine should have so many different smells; around 700 different flavor compounds have been identified. (Jim Budd, 1996)

1.10.3 Taste



Picture 6: taste wine tasting (Jim Budd, 1996)

Take a good sip of wine and slosh it around your mouth. If you can take in little gasps of air through your teeth at the same time without choking, the flavor will be enhanced. Different parts of your mouth are sensitive to different sensations. As well as the flavors of wine, taste is also about "mouth feel", how about the texture, and the flavor change in your mouth. (Jim Budd, 1996)

1.11 Serving wine

Serving fine wine doesn't stop at the selection of a quality vintage. Storage, temperature and glassware are key ingredients in a wine's taste.

1.11.1 Temperature

Picture 7: serving wine bottle (Jim Budd, 1996)

If wine is served too cold it may well be refreshing on a hot day but it is taste and aroma will be muted. White wine need to be sufficiently chilled to be refreshing, otherwise it will be uninteresting. Equally, wine is not being served to hot. Because of the low boiling point for alcohol, a wine that is too warm (over 70°F) becomes unstable as the alcohol starts to evaporate. It will start to smell spirit. The best thing to do is to put the bottle into an ice bucket with some cold water.

When serving red wine, the bottle should be cool to the touch, but not cold. Temperatures for serving whites are not so critical, but beware of over chilling and avoid storing white wine in the refrigerator for long periods. Both tend to deaden flavor. It is best to chill white wine, as it is needed. The best way is in an ice bucket for 20 to 30 minutes with a mixture of ice and water. (Jim Budd, 1996)

Table 4: temperature chart (Jim Budd, 1996)

Temperature	Wine
68°F	Too hot
66°F	Too hot
62–65°F	Robust reds: Bordeaux, Cabernets from Australia, California, and Chile: Midi wines. Barolo and

Temperature	Wine
	Amarone.
55–61°F	Most medium-bodied reds; heavier Loires, Chianti, Valpolicella, red Burgundy.
51–54°F	Best white Burgundy; top Chardonnays from Australia, California, Chile, Limoux, Oloroso sherry. Also light reds on a hot day.
44–50°F	Fino and manzanillia sherry. Top Champagne. Most white wines and rose.
37–43°F	Sparkling wines. Any white that is not expected to taste very nice as cold will the flavor.
32–36°F	Too cold

1.11.2 Wine glass

Wine always seems to taste better out of a good glass. The right glass can enhance the taste of particular wine styles. A good, all-purpose wine glass need not be expensive. It should be slightly tapered or tulip-shaped at the top, which helps to concentrate the bouquet when the wine is swirled around in the glass. Much of what we taste is really what our nose tells us about the wine. Make sure your glasses are clean, which means careful rinsing in warm or hot water and avoidance of the use of detergent in washing. Glasses should be stored upright and aired before use. (Jim Budd, 1996)

Picture 8: serving wine in restaurant (Jim Budd, 1996)

1.12 Choosing and buying wine

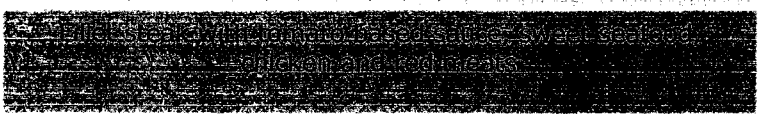
The range of wine available varies greatly from country to country. The best and most interesting way of buying wine is to buy it at the vineyard from the people who made it. Or ales wine can be buy at the supermarket, a nation wine merchant chain, in case of the everyday wine. For the special and wine, such as Vintage Ports or expensive Bordeaux or Burgundy, the best place to go is the independent merchant. (Jim Budd, 1996)

Wine can be choosing depend on the Vintage guide or *En primeur.* Vintage charts appear to give easy information about what is a good year, which are average and which to avoid. *En primeur* means that the consumer pays for the wine before it has been bottled. Transport and taxes will be paid later when the wine has been bottled and is ready to be shipped. This way is buying the wine depending on their prices. Wine can be choosing depend on food also. (Jim Budd, 1996)

1.12.1 Choosing wine depend on food

Table 5: matching wine with food

Wine type	Food type
Chardonnay Medium to full-bodied, dry.	Poultry, shellfish, veal, pork, rabbit, fish and pasta dishes prepared with cream and/or butter, mushrooms
Sauvignon Blanc Light-medium bodied, dry.	First courses, seafood, ethnic dishes—pastas, curries, salsas, spicy sausages, vegetable dishes, luncheon salads, olive-oil based dishes, tomato sauces, goat cheese.
Chenin Blanc Light to medium-bodied, normally off-dry to semi-sweet.	Spicy cuisines such as Chinese, Mexican, and Indian, mild sausages, fruit salad.
Traminer Light to medium body, usually semi-sweet, occasionally off-dry.	
Riesling Light to medium bodied, semi-sweet to off-dry.	Grilled fish, foods with creamy sauces such as pasta
Semillon Medium bodied dry white	

Wine type	Food type
Verdelho Medium bodied dry white	
Cabernet Sauvignon Medium to full-bodied, tannic and dry.	Beef, lamb, pork, duck, game meats, cheeses.
Merlot Medium to full-bodied, less tannic than Cabernet, dry.	
Shiraz Medium to full bodied	Beef fillet with tomato based sauce. Rich spicy meals. Veal, kangaroo, roast duck. Sparkling shiraz goes well with pastries and puddings.
Grenache Medium to full bodied dry red	
Pinot Noir Medium to light-bodied, dry, little tannin leaves silky texture.	Lamb, duck, turkey, game birds, beef, rabbit, semi-soft cheeses.
Rosé Vary greatly in the level of residual sugar (sweetness).	
Brut Dry	Aperitifs and first courses, fruits and nuts. Fuller bodied variations go well with any fish and chicken
Blanc de Noir Dry but more fruity than Brut. Made from Red grapes only.	
Blanc de Blancs Delicate dry wine made from white grapes only.	Caviar. Anytime

1.13 Trend of wine consumption in Thailand

1.13.1 Study of wine consumption behavior in Bangkok

Table 6: type of popular alcoholic beverage: (สยุมพร แพทวีทรัพย์, 2542)

Type of alcoholic beverage	Amount (person)	Percentage (%)
Whisky	221	50.25
Beer	302	75.50
Brandy	84	21
Chinese beverage	12	3
Champagne	31	7.75

Type of alcoholic beverage	Amount (person)	Percentage (%)
Wine	343	85.75
others	17	4.25

Table 7: Occasion for wine drinking (สยุมพร แพทวีทรัพย์, 2542)

Occasion	Amount (person)	Percentage (%)
Drink regularly at home	44	11
Drink in the party	356	89
Total	400	100

Table 8: Brand royalty (สยุมพร แพทวีทรัพย์, 2542)

Brand royalty	Amount (person)	Percentage (%)
Specific	72	18
Nonspecific	328	82
Total	400	100

Table 9: frequency of wine drink (สยุมพร แพทวีทรัพย์, 2542)

Frequency	Amount (person)	Percentage (%)
Every day	18	4.50
Sometimes	335	83.75
Often	47	11.75
Total	400	100

Table 10: volume of wine drinking (สยุมพร แพทวีทรัพย์, 2542)

Volume of wine drinking	Amount (person)	Percentage (%)
1-3 glass	251	59.75
4-6 glass	111	27.75

Volume of wine drinking	Amount (person)	Percentage (%)
More than 6 glass	50	12.50
Total	400	100

Table 11: country which making wine (สยุมพร แพทวีทรัพย์, 2542)

Country	Rank 1	Score	Rank 2	Score	Rank 3	Score	Total score	Rank
France	239	717	70	140	35	35	892	1
Chili	41	123	77	154	61	61	338	2
England	16	48	68	136	40	40	224	6
Australia	23	69	83	166	69	69	304	3
USA	25	75	54	108	96	96	279	4
Thai	44	132	22	44	56	56	232	5
Germany	12	36	20	40	37	37	113	7
Etc.	0	0	6	12	6	6	18	8
Total	400	1200	400	800	400	400	2400	

Table 12: level of price of wine that the consumer chooses to buy. (สยุมพร แพทวีทรัพย์, 2542)

Level of price (bath)	Amount (person)	Percentage (%)
Below 300	63	15.75
301-500	92	23
501-1000	174	43.50
1001-2000	71	17.75
Total	400	100

1.13.2 Statistics of import and export wine in Thailand

Table 13: Statistics of import and export wine in Thailand (www.customs.go.th)

Years	Statistics	
	Total Import (CIF value, Baht)	Total Export (FOB value, Baht)
2001	320 559 885	71 278 504
2002	320 477 861	87 336 427
2003*	138 029 131	47 386 524

Remark: year 2003 cover only Jan-May

2 Banana

2.1 Bananas morphology

The banana is important in the humid tropical lowlands, because it can be easily grown with year-round fruiting. It also provided as a main source of nutrition for some developing country. The commercial banana is a giant, perennial, herbaceous monocotyledon, belonging to the family *Musaceae*, genus *Musa*. There are many varieties of the banana in Thailand such as:

- Kluay Hom, กล้วยหอม (*Musa sapientum*, Linn. (Gros Michel) *Musa*, AAAgrup)
- Kluay Namva, กล้วยน้ำว้า (*Musa Sapientum*, Linn. *Musa*, ABB group)
- Kluay Khai, กล้วยไข่ (*Musa Sapientum*, Linn *Musa*, AA group)
- Kluay Hukmuk, กล้วยหักมุก (*M. paradisiacal var. sapientum*, Linn *Musa*, ABBgroup)
- Kluay Roiwee, กล้วยร้อยหวี (*Musa chiliocarpa*, Backer. *Musa*, AAB group)
- Kluay Nomsao, กล้วยนมสาว (*Musa*, AAB group)
- Kluay Lebmuenang, กล้วยเล็บมือนาง (*Musa nana*, Loureiro. *Musa*, Aagroup)
- Kluay Hin, กล้วยหิน (*Musa*, ABB group), and etc.

The banana plant is a large, tree-like, determination perennial herb with a basal rhizome. A pseudo stem composed of leaf sheets, and a terminal crown of large leaves which reaching a height of 2-8 m in cultivate varieties and up to 10-15 m in some wild species and also have the large leave area. The leaves area is varies between cultivars and depend upon growing conditions. The areas of individual leaves of dessert bananas being 1.27-2.80 m^2 but plantain are 0.68-0.92 m^2. The stem or rhizome is underground which corm has bud producing short rhizomes and shoots near the parent.

The terminal in florescence is initiated near ground level and is then emerges through the center of pseudo stem and bend downward after extrusion by elongation of the fruit bunch. The flowering spike consists of groups of two rows of appressed flowers enclosed within large, ovate, reddish bracts at each node or hand. The female flowers emerge first and the males are distal. The male flower clusters are not produce fruit and are also commonly deciduous. There are 12-20 flowers per hand and 5-15 nodes with female flowers. The peduncle continues to elongate up to 1.5 m, which make banana become the largest inflorescence of any plant grown as a crop.

Banana bunches take 2-6 months to mature, they are pendant or sub horizontal and usually weighed between 10 to 60 kg. One bunch may compose 16 hands with up to about 30 fingers per hands, and the bunch can weight up to 70 kg. The fingers are varying in dimensions, depending on the varieties. Usually they are 15-30 cm long and weight 50-200 g. Normally, the fruit are green. When ripen, the fruits change their color to yellow. Young fruits are usually angular, but as maturing, they become rounder.

Bananas are parthenocarpic berry, its fruits can develop without pollination, although it develops from inferior ovary instead. The exocarp is made up of the parenchyma layer, with the flesh being the mesocarp. The endocarp is composed of a thin lining next to the ovarian cavity. However, fertilization can take place with the result of dark hard seed of 3-5 mm in diameter inside the fruits. The ovules shrivel early but can still be recognized as brown specks in the central part of mature fruit.

Banana fruit is covered with thick peel. The ratio of pulp to peel can be varied from 1:1 to 4:1, depending on varieties and maturity of the fruit. Usually when the fruit ripens, the ratio increases. This is due to the movement of water from the peel into the pulp, as starch inside the pulp. (Jariy and Suwanna, 1996)

2.2 Nutrient composition of banana

Table 14: components per 100 g edible portion of banana (Jariy and Suwanna, 1996)

Components	Proximate analysis
Water (g)	70.7
Sugars (g)	16.2
Starch (g)	3.0
Dietary fiber (g)	3.4
Total nitrogen (g)	0.18
Protein (g)	1.1
Fat (g)	0.3
Sodium (mg)	1
Potassium (mg)	350
Calcium (mg)	7
Magnesium (mg)	42
Phosphorus (mg)	28
Iron (mg)	0.4
Copper (mg)	0.16
Zinc (mg)	0.2
Sulfur (mg)	13
Chlorine (mg)	79
Retinal (g)	0
Carotene (g)	200
Vitamin D (g)	0
Thiamin (mg)	0.04
Riboflavin (mg)	0.07
Nicotinic acid (mg)	0.6
Ascorbic acid (mg)	10
Vitamin E (mg)	0.2
Vitamin B6 (mg)	0.51
Vitamin B12 (mg)	0
Folate (g)	22
Pantothenate (mg)	0.26

Table 15: composition per 100 g for edible portion of some varieties of banana in Thailand. (Jariy and Suwanna, 1996)

Nutrient composition per 100 g of edible portion	Food item			
	Kluay Khai	Kluay Namva	Kluay Hom	Kluay Hukmuk
Energy (kcal)	140	139	125	112
Moisture (g)	62.8	62.6	66.3	71.2
Protein (g)	1.5	1.1	0.9	1.2
Fat (g)	0.2	0.2	0.2	0.2
Carbohydrate (g)	32.9	33.1	29.8	26.3
Crude fiber (g)	0.4	0.3	0.3	0.4
Dietary fiber (g)	1.9	2.3	1.9	-
Ash (g)	0.7	0.7	0.9	0.7
Calcium (mg)	4	7	26	7
Phosphorus (mg)	23	43	46	48
Iron (mg)	1.0	0.8	0.8	0.8
Retinal (μg)	-	-	-	-
Thiamin (mg)	0.03	0.04	0.04	0.08
β-Carotene (μg)	492	54	99	-
Total A (RE) (μg)	82	9	17	-
Total A (IU) (μg)	-	-	-	116
Thiamin (mg)	0.03	0.04	0.04	0.08
Riboflavin (mg)	0.05	0.02	0.07	0.11
Niacin (mg)	1.4	1.4	1.0	0.8
Vitamin (mg)	2	11	27	1

2.3 Ripening of banana

Ethylene gas, concentration of 1000 mg/l, in humidified room at 15-18°C is used to accelerate ripening process. The ripening bananas have relatively short life. Usually it is from 2-10 days, depending on variety and temperature. This is due to their high rate of metabolism. The rate of respiration during the climacteric is 100-180 ml of oxygen per kg of fruit per hour and 40-60 whilst green. Lower temperature will reduce the metabolic rate,

but chilling injury occurs when the fruit for a long period below 13°C.

2.4 Banana fig

The banana fig can be made by using the over ripe banana as a raw material. Then peel the skin out and dry it under sunlight for 1-2 days until the color of banana is change into dark brown color which mean the browning reaction is already occur. At the end the dry banana is rolled and pressed into fix shape.

Banana figs is the well-known banana processing product and also famous in Thailand. Thai have been produced banana fig and export it to aboard for many years. The favor type of banana suitable for making banana fig is Kluay Namva while Kluay Hom, Kluay Khai, Kluay Hukmuk are not favor which may because both Kluay Hom and Kluay Khai contain high percentage of water with less amount of starch when ripe and Kluay Hukmuk contain too much of starch. This makes the best banana fig is made from Kluay Namva. (เบญจมาศ ศิลาย้อย, 2534)

The best banana figs are from Bangkratum, Pisanuloak province that is made from Kluay Namvakhao, *Musa* (ABB group). This kind of banana has sweet taste and beautiful color No sugar is adding, the sweet flavor is from banana itself only. With the new technology now, the sunlight energy is use to perform the huge oven for making banana figs or bake. This indirect way gives the clean banana fig product more than dry it directly under sunlight because no contaminated with undesirable things such as fruit fly or dust. (เบญจมาศ ศิลาย้อย, 2534)

Table 16: composition per 100 g for edible portion of both fresh banana (Kluay Namva) and banana fig. (เบญจมาศ ศิลาย้อย, 2534)

Nutrient composition	Raw banana (Kluay Namva)	Mature banana (Kluay Namva)	Banana fig
Moisture (%)	69.0	71.6	30.8

Nutrient composition	Raw banana (Kluay Namva)	Mature banana (Kluay Namva)	Banana fig
Energy (calorie)	110.0	100.0	266.0
Fat (g)	0.2	0.3	0.1
Carbohydrate (g)	28.7	26.1	64.1
Protein (g)	1.4	1.2	2.2
Calcium (mg)	8.0	12.0	12.0
Phosphorus (mg)	35.0	32.0	84.0
Iron (mg)	0.9	0.8	1.3
Vitamin A (IU)	483.0	375.0	-
Vitamin B1 (mg)	0.04	0.03	0.05
Vitamin B2 (mg)	0.02	0.04	0.11
Niacin (mg)	0.6	0.6	-
Vitamin C (mg)	31	14.0	3

In case of exportation, it is necessary to concern about the standard quality of the banana fig. For example, European market limits the standard quality of banana fig as:

- The product must contain smooth golden yellow color
- No contamination subjects
- The texture should be firm and sweet without sugar coating
- No contamination of mold, bacteria, and insect

(เบญจมาศ ศิลาย้อย, 2534)

And they are grading the product according to its size as:

- Grade 1 must contain length longer than 4.5 inches
- Grade 2 must contain length longer than 4-4.5 inches
- Grade 3 must contain length shorter than 4 inches

(เบญจมาศ ศิลาย้อย, 2534)

The product will be fill in the plastic bag and weight each bag to contain product 250 g or 500 g before pack in the paper box. One paper box should contain banana fig about 12.5 kg. (เบญจมาศ ศิลาย้อย, 2534)

The countries, which buy banana fig from Thailand, are Switzerland, Canada, France, Singapore, USA, England, and Saudi Arabia. (เบญจมาศ ศิลาย้อย, 2534)

MATERIAL AND METHOD

The following materials are use for the preparation of banana fruit wine.

Material

1. Raw material
1.1 Banana fig, suankloi brand
1.2 Kluay Namva, *Musa sapientum* (ABB group)
1.3 Water
1.4 Sucrose syrup
1.5 Honey from longan flower, Honey brand
1.6 Yeast
1.7 KMS

2. Material for fermentation process
2.1 Fermenter
2.2 Yeast
2.3 Ladle
2.4 Pod
2.5 Gas stove

3. Material for wine filtration
3.1 Connel
3.2 Wattman Filter paper no.4 and no.1
3.3 Diatom
3.4 1000 ml suction flask
3.5 Vacuum pump
3.6 2 liter beaker
3.7 Stirring rod
3.8 Rubber hose
3.9 Bottle
3.10 Cone

4. Material for chemical measurement
4.1 Ebulliometer, Dujardin-Salleron
4.2 Reducing sugar kit, cilinitest®

4.3 pH meter, Denver Instrument, Model 15
4.4 Refractometer, Tamco
4.5 50-ml burette
4.6 250-ml Erlynmeyer flask
4.7 5-ml volumetric pipette
4.8 10-ml volumetric pipette
4.9 20-ml volumetric pipette
4.10 Dropper

5. Reagent for chemical measurement
5.1 0.1*N* sodium hydroxide
5.2 1% phenolphthalein indicator solution
5.3 0.025*N* iodine
5.4 25% sodium hydroxide
5.5 25% sulfuric acid
5.6 1% starch solution
5.7 Bicarbonate of soda

6. Material for calculate sensory analysis
6.1 SPSS for window® version 10.0 program

Method

1. Study the effect of the different factors to the wine product

This is use the RCBD experiment under 3 important factors. These factors are the ratio of banana fig to water, types of banana (fresh banana and banana fig) and types of sugar source (sucrose syrup and honey).

The ratio of banana fig to water is varying into 4 levels; 1:3, 1:4, 1:5, and 1:7 for fermenting and honey was added to increase the sweetness into 22 °Brix in every sample. In case of sucrose syrup was used as sweetener the ratio of banana fix and water will be vary at 3 levels, which are 1:3, 1:4, and 1:7.

The fermentation method is done by cut the banana fig into little piece, boil it for 5 minutes and fill in the one gallon fermentation jar. Let it stand until cool then measure the °Brix. Adjust to 22 °Brix and add KMS (200 ppm) to kill the unwanted organisms. Leave it over night. Add 2-3 drops of amylase and pectinase then inoculate with yeast powder (1 g of yeast powder per 1 liter of wine). The fermentation will last around 2 weeks.

For fresh banana, it will be cut into small pieces including with its skin. Then fill in the one gallon fermentation jar. Adding hot syrup to adjust °Brix to 24°Brix, let it stand until cool then put 2-3 drops of amylase and pectinase. After that inoculate with yeast powder (1 g of yeast powder per 1 liter of wine). The fermentation will last around 2 weeks.

2. Chemical analysis of the banana fig wine

2.1 Measure the amount of percent alcohol by ebulliometer method. (Richard P. Vine, Ellen M. Harkness and Theresa Browning, Cheri wagner, 1997)

2.2 Measure the amount of reducing sugar in wine by useing the reducing sugar kit method.

2.3 Measure the pH value by pH meter.

2.4 Measure the total soluble solid (°Brix) by reflactometer method. (Richard P. Vine, Ellen M. Harkness and Theresa Browning, Cheri wagner, 1997)

2.5 Measure the amount of total sulfur dioxide by modified Ripper method.

2.6 Measure the amount of total acidity by titration method. (Richard P. Vine, Ellen M. Harkness and Theresa Browning, Cheri wagner, 1997)

3. Sensory evaluation by testing the acceptable of consumer to the banana fig wine comparing with control fresh banana wine

This is test by following the 20-point scale method (panelist rank the score freely depend on their like or dislike) to test these qualities that are color, clarity, tear, aroma, and taste. The test will be done by 15 special panelists, 8 samples will be served to the panelist for rank the score according to the scale point.

The acceptable analysis result of consumer will be analyzed by SPSS 10.0 for window program.

4. Research location

Pilot plant, school of Biotechnology, Assumption University.

5. Duration of researching.

Started from December 2002 and finished on June 2003.

RESULT AND DISSCUSSION

1. Study on the effect of different sweetener source and different banana fig to water ratio in the fermentation.

1.1 Determination the suitable ratio of banana fig to water by using sucrose syrup as sweetener.

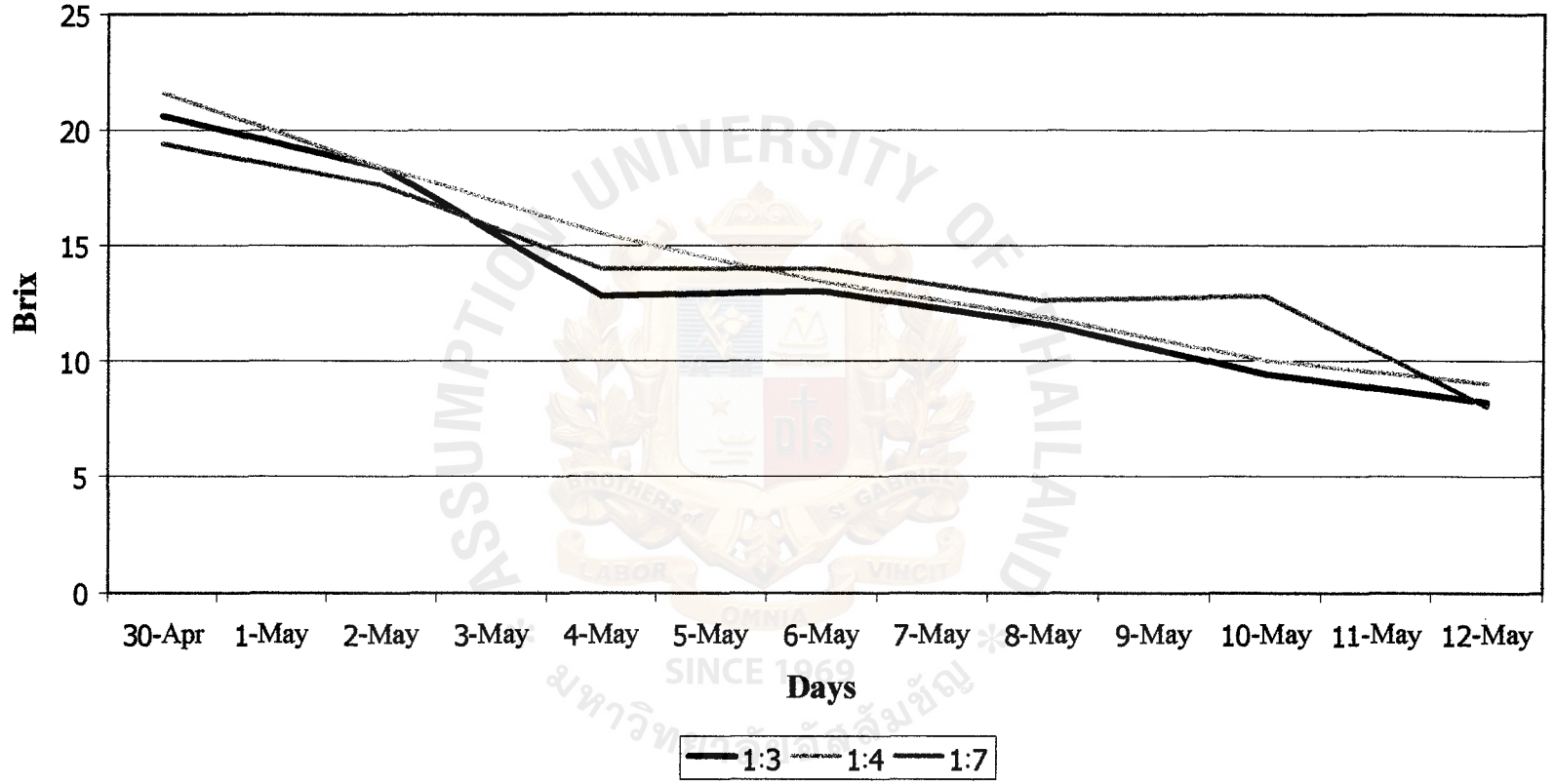
Table 17: the chemical analysis of banana fig wine at different ratio of banana fig to water fermented with sucrose syrup.

Banana fig to water (w/v)	Final pH	Total soluble solid (°Brix)	% Alcohol by volume	Total titratable acidity (g/100 ml T.A.*)	Total sulfur dioxide (ppm)	% Reducing sugar	Color
1:3	4.6	8.2	12	<0.383	8	1.5	9/6(5y)
1:4	4.5	9	10.1	<0.383	8	2	9/6(5y)
1:7	4.2	8	9.8	<0.383	8	2	9/4(5y)

Remark: T.A. = tartaric acid

The results of chemical analysis of 3 different ratios of banana fig to water; 1:3, 1:4, 1:7 are shown in table 17 when according to the standard quality of wine in table 2, its quality is acceptable. Figure 1 that is shown below; represent the carbohydrate utilization of yeast. At ratio 1:4, utilization is constantly all along the fermentation time, so that in this ratio less opportunity for yeast to get error during the fermentation. At ratio 1:3 and 1:7, utilization is rapidly during the first five days. Nevertheless, it is quite hard to conclude from the graph that which ratio is the optimum for yeast to produce alcohol but from table 17, ratio 1:3 is present the highest amount of alcohol volume. The higher volume of Banana fig added yeast can higher amount of alcohol. Therefore the ratio 1:3 is selected as an optimum condition.

Figure 1: % total soluble solid decreasing during fermentation of banana fig with sucrose syrup



Remark: measuring is start from the first day of fermentation.

1.2 Determination of the suitable ratio of banana fig to water by fermented with honey

Honey has been defined by the USFDA (US Food and Drug Administration) as the nectar and saccharine exudation of plants gathered, it is modified and stored in the comb of honeybee (*Apis mellifera* and *Apis dorsata*). Modification procedures performed by the bee after the nectar is carried to the hive include inversion of sucrose in the nectar, and concentration to over 80% solid. (S. Marie and J.R. Pigott, 1991)

According to the standard quality of wine in table 2, the quality of this wine product from table 18 is acceptable.

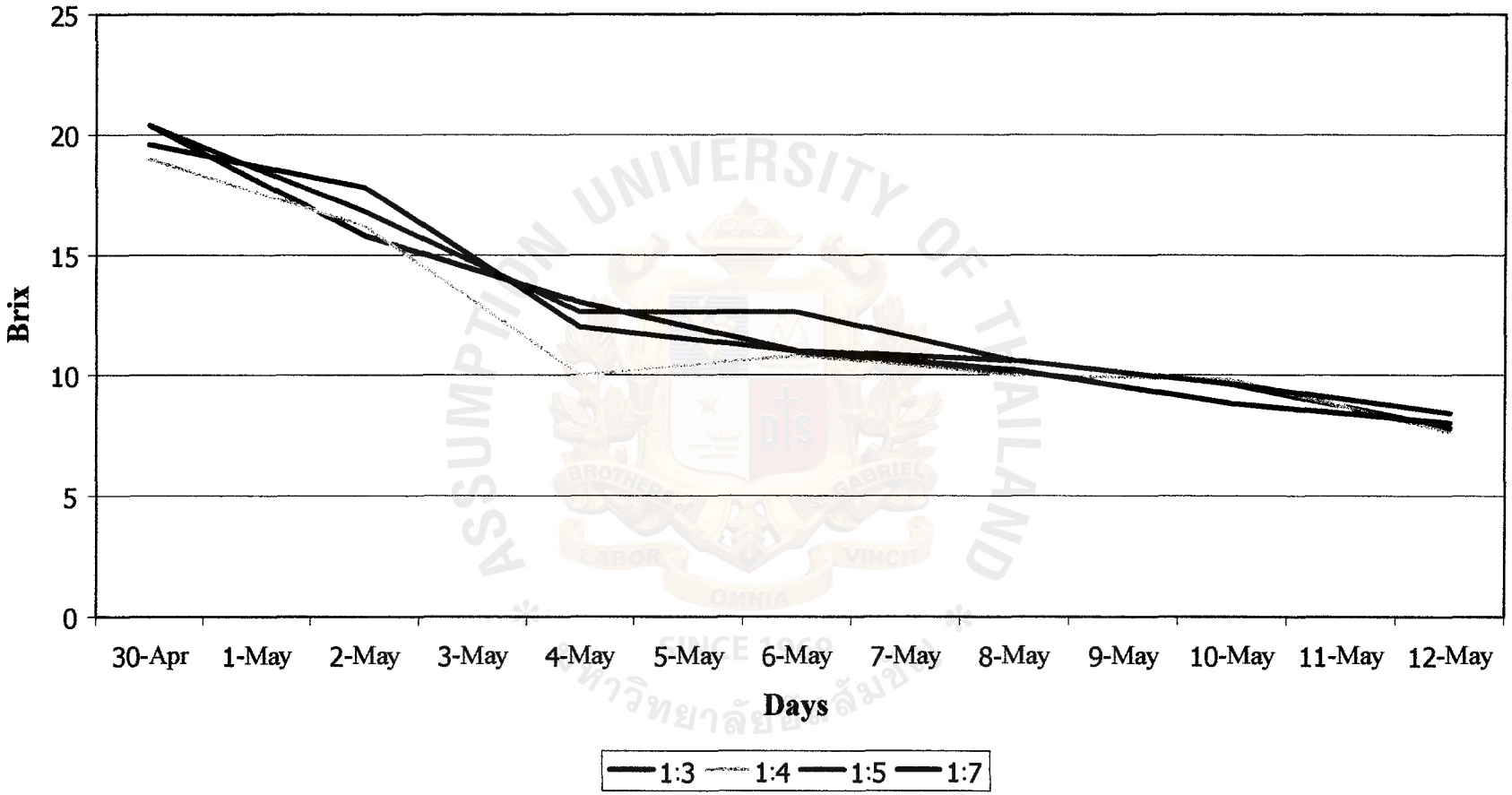
Table 18: the chemical analysis of banana fig wine from banana fig to water fermented with honey in each ratio.

Banana fig to water (w/v)	Final pH	Total soluble solid (°Brix)	% Alcohol by volume	Total titratable acidity (g/100 ml T.A.*)	Total sulfur dioxide (ppm)	% Reducing sugar	Color
1:3	4.6	7.4	11	<0.383	12	1	9/6(5y)
1:4	4.4	7	10	<0.383	8	1	9/4(5y)
1:5	4.3	7.4	10	<0.383	16	1	9/4(5y)
1:7	4.2	7.4	10.6	<0.383	12	1	9/4(5y)

Remark: T.A. = tartaric acid

Figure 2 present carbohydrate utilization of yeast; utilizing is rapidly during the first 6 days for the ratio 1:3 while others are utilized rapidly at first 5 days then utilizing decreases slowly. On the contrary it is quite hard to conclude from this graph that which ratio is the optimum. But from table 18 ratio 1:3 is present the highest amount of alcohol volume which means yeast has the best activity among these 4 ratios. Then the ratio 1:3 will be selected as the finest ratio.

Figure 2: % total soluble solid decreasing during fermentation of banana fig with honey



Remark; measuring is start from the first day of fermentation

1.3 Comparison of wine making from banana fig between the difference sugar sources

Banana fig, when fermented with sucrose syrup and honey given the different result. The obvious attribute determined from the chemical analysis.

Table 19: the chemical analysis comparison of banana fig fermented with sucrose syrup and honey.

Treatment (w/v)	Final pH	Total soluble solid (°Brix)	% Alcohol by volume	Total titratable acidity (g/100 ml T.A.*)	Total sulfur dioxide (ppm)	% Reducing sugar	Color
1:3 sucrose	4.6	8.2	12	<0.383	8	1.5	9/6(5y)
1:3 honey	4.6	7.4	11	<0.383	12	1	9/6(5y)

Remark: T.A. = tartaric acid.

By using the chemical analysis table above, the ratio 1:3 sucrose contains the slightly higher percentage of alcohol by volume. Therefore the activity of yeast in this ratio should be better than the 1:3 honey. This selection is also decided by using other information such as production cost. This is supported by the data on Table 20. Wine made with sucrose syrup has a lower production cost.

Table 20: cost of production comparing between honey and sucrose syrup

Cost (Baht)	Wine with difference sugar source	
	Sucrose syrup	Honey
Cork (baht/piece)	0.75	0.75
Cap (baht/piece)	0.75	0.75
Label (baht/piece)	7.5	7.5

Cost (Baht)	Wine with difference sugar source	
	Sucrose syrup	Honey
Bottle (baht/bottle)	7.5	7.5
Stamp (baht/piece)	25	25
Raw material (baht/kg)	58.33	58.33
Sugar (baht/kg)	14	176
Water and gas	5%	5%
Total (baht/bottle)	68.63	153.35

1.4 Comparisons of wine making by using banana fig and fresh banana.

Table 21 shows the chemical analysis between banana fig and fresh banana fermented with sucrose syrup and honey. From result shown in table 21 there is no significant different in chemical composition in all samples. So it is necessary to use other factor to determine the best condition for making wine such as taste, aroma and color.

Table 21: chemical analysis of the banana fig wine and fresh banana wine

Treatment (w/v)	Final pH	Total soluble solid (°Brix)	% Alcohol by volume	Total titratable acidity (g/100 ml T.A.*)	Total sulfur dioxide (ppm)	% Reducing sugar	Color
1:3 sucrose	4.6	8.2	12	<0.383	8	1.5	9/6(5y)
1:3 honey	4.6	7.4	11	<0.383	12	1	9/6(5y)
Fresh Banana	4.5	11	12	<0.383	10	>2	9/2 (5yr)

Remark: T.A. = tartaric acid

1.5 Sensory evaluation test of banana fig wine

- Sensory evaluation by using 20-point scale test

The result of wine tasting by 15 wine specialized panelists
Female: 6 persons
Male: 9 persons
Age between: 20-45 years

For sensory test, 15 panelists evaluated 8 samples of wine prepared from banana fig and fresh banana fermented with sucrose syrup, honey and to measure the acceptance ratio. The data were analyzed by ANOVA to determined whether the samples were significant different and Scheffe was performed when there was a significant difference. The result is summarized in table 22.

Table 22: sensory analysis from SPSS program

Attributes		Treatments							
		SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
Appearance	Clarity	1.87^{a}	1.87^{a}	2^{a}	1.92^{a}	1.9^{a}	1.93^{a}	1.97^{a}	1.83^{a}
	Color	1.73^{b}	1.8^{b}	1.67^{b}	1.67^{b}	1.85^{b}	1.68^{b}	1.43^{ab}	1.01^{a}
Nose and bouquet	Aroma	1.15^{a}	0.85^{a}	0.9^{a}	0.95^{a}	0.96^{a}	0.85^{a}	0.7^{a}	0.83^{a}
	Condition	0.7^{a}	0.7^{a}	0.7^{a}	0.73^{a}	0.9^{a}	0.8^{a}	0.84^{a}	0.78^{a}
	Develop	0.91^{a}	0.75^{a}	0.81^{a}	0.71^{a}	0.75^{a}	0.81^{a}	0.84^{a}	0.78^{a}
	Quality	0.71^{a}	0.64^{a}	0.73^{a}	0.8^{a}	0.85^{a}	0.79^{a}	0.62^{a}	0.68^{a}
Palate	Body	1.43^{a}	1.37^{a}	1.52^{a}	1.72^{a}	1.85^{a}	1.45^{a}	1.28^{a}	1.11^{a}
	Flavor	1.07^{a}	1.35^{a}	1.31^{a}	1.7^{a}	1.63^{a}	1.53^{a}	1.17^{a}	1.24^{a}
	Balance	1.45^{a}	1.18^{a}	1.11^{a}	1.3^{a}	1.47^{a}	1.43^{a}	1.03^{a}	1.07^{a}
	Finished	0.95^{a}	1.09^{a}	1.14^{a}	1.44^{a}	1.65^{a}	1.4^{a}	1.13^{a}	0.87^{a}
Exceptional characteristics		0.73^{a}	0.71^{a}	0.83^{a}	1.08^{a}	1.3^{a}	0.92^{a}	0.62^{a}	0.53^{a}

1.5 Sensory evaluation test of banana fig wine

- Sensory evaluation by using 20-point scale test

The result of wine tasting by 15 wine specialized panelists
Female: 6 persons
Male: 9 persons
Age between: 20-45 years

For sensory test, 15 panelists evaluated 8 samples of wine prepared from banana fig and fresh banana fermented with sucrose syrup, honey and to measure the acceptance ratio. The data were analyzed by ANOVA to determined whether the samples were significant different and Scheffe was performed when there was a significant difference. The result is summarized in table 22.

Table 22: sensory analysis from SPSS program

Attributes	Treatments							
	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
Clarity	1.87^{a}	1.87^{a}	2^{a}	1.92^{a}	1.9^{a}	1.93^{a}	1.97^{a}	1.83^{a}
Color	1.73^{b}	1.8^{b}	1.67^{b}	1.67^{b}	1.85^{b}	1.68^{b}	1.43^{ab}	1.01^{a}
Aroma	1.15^{a}	0.85^{a}	0.9^{a}	0.95^{a}	0.96^{a}	0.85^{a}	0.7^{a}	0.83^{a}
Condition	0.7^{a}	0.7^{a}	0.7^{a}	0.73^{a}	0.9^{a}	0.8^{a}	0.84^{a}	0.78^{a}
Develop	0.91^{a}	0.75^{a}	0.81^{a}	0.71^{a}	0.75^{a}	0.81^{a}	0.84^{a}	0.78^{a}
Quality	0.71^{a}	0.64^{a}	0.73^{a}	0.8^{a}	0.85^{a}	0.79^{a}	0.62^{a}	0.68^{a}
Body	1.43^{a}	1.37^{a}	1.52^{a}	1.72^{a}	1.85^{a}	1.45^{a}	1.28^{a}	1.11^{a}
Flavor	1.07^{a}	1.35^{a}	1.31^{a}	1.7^{a}	1.63^{a}	1.53^{a}	1.17^{a}	1.24^{a}
Balance	1.45^{a}	1.18^{a}	1.11^{a}	1.3^{a}	1.47^{a}	1.43^{a}	1.03^{a}	1.07^{a}
Finished	0.95^{a}	1.09^{a}	1.14^{a}	1.44^{a}	1.65^{a}	1.4^{a}	1.13^{a}	0.87^{a}
Exception	0.73^{a}	0.71^{a}	0.83^{a}	1.08^{a}	1.3^{a}	0.92^{a}	0.62^{a}	0.53^{a}

Remark: - different in [a] and [b] of the same horizontal column means the significant difference at $\alpha = 0.05$ level.

- 8 samples are listed below:

SW1 = the ratio of 1:3 banana fig to honey syrup

SW2 = the ratio of 1:4 banana fig to honey syrup

SW3 = the ratio of 1:5 banana fig to honey syrup

SW4 = the ratio of 1:7 banana fig to honey syrup

SW5 = the ratio of 1:3 banana fig to sucrose syrup

SW6 = the ratio of 1:4 banana fig to sucrose syrup

SW7 = the ratio of 1:7 banana fig to sucrose syrup

SW8 = the fresh banana wine

According to the table above, it was found that there was significant difference only in color attribute. Most of the panelist preferred color of banana fig wine than the fresh banana wine. Due to this result, ratio 1:3 banana fig to sucrose syrup is chosen, this is also support by its chemical composition and the cost of production. The result from chemical analysis among these 8 samples, compared above, show that this sample present high quality while the production cost is low. So with this, it is reasonable to choose this sample for produce and sell the product in the market.

2. Judgment on using banana fig instead of fresh banana for wine making

Banana fig is made from mature banana by peeling of its skin and dry under the sunlight (เบญจมาศ ศิลาย้อย, 2534). Because banana fig is the fresh banana, which is already pass through the preservation process then the cost will be higher than fresh banana. The reason for use the processed raw materials instead of fresh raw materials are:

2.1 Storage limitation

Banana fig is one of the products from the heat preservation process for proposes of prolong the product shelf life. So when compare this product with the fresh banana, the banana fig can be store for at most half year under the suitable condition while banana can store only one week. Then producers are able to buy a lot of raw material with cheap for reduce the cost of production, and also possible to ferment wine from the same lot of raw material to control the quality of the final product.

2.2 Quality of raw material and final product can be control

Wine made from fresh banana is difficult to control quality, due to the stability of the maturity in each lot. Because fresh banana is vary so much in the starch content. In the case of banana figs, that pass through the process, it is easier to obtain the raw material with more stable starch content.

2.3 Better quality of wine

This is the third and also important reason to support that banana fig wine is better than fresh banana wine. According to the color attribute in table 21, most of the consumer prefers the banana fig

wine than the fresh banana wine because it gives the better color than the fresh banana.

2.4 Value added to the banana product

Table 23: cost and benefit of selling banana fig wine comparing with banana fig

Type	Cost (Baht/kg)	Benefit (Baht/kg)
Banana fig	20	18.33
Banana fig wine	68.63	81.37

Remark: 1 kg = wine 3 bottles

Table 23 above demonstrates that selling banana fig wine will give the better benefit than selling banana fig.

CONCLUSION

From the result of the experiment of banana fig wine production, it was found that:

1. The optimum condition for fermentation process done by s. cerevisiae of banana fig wine is ratio 1:3 banana fig to water fermented with sucrose syrup.

2. When comparing the chemical composition between banana fig wine and fresh banana wine, the yeast activity of the banana fig is equal to that of fresh banana wine.

3. The result from sensory evaluation, only color attribute of each sample presents the significant different at $\alpha = 0.05$.

4. The ratio of 1:3 banana fig to water fermented with sucrose syrup is chosen with the support data of sensory evaluation, high quality and the lowest cost of production.

5. The banana fig is chosen because of many reasons.
   - It can be storage of a long time
   - Quality of raw material is controllable
   - Presentation of better color than the fresh banana wine product
   - Value added to the banana fig.

SUGGESTION

Enzyme amylase and pectinase should be added to the step of filtration and increase the clarity of final product.

The change of percentage of alcohol should be inspected during fermentation period to determine the proper fermentation rate.

Table 6-12 shows that wine are the favorite alcoholic beverage for most people in Bangkok. Reference in table 13 show the importation and exportation rate of wine in Thailand has the trend to increase every year. However from the study we learned that the import ratio rate is higher than export. Therefore if we can persuade Thai people to produce a better quality of Thai wine, the volume of importation can be reduce.

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APPENDIX A

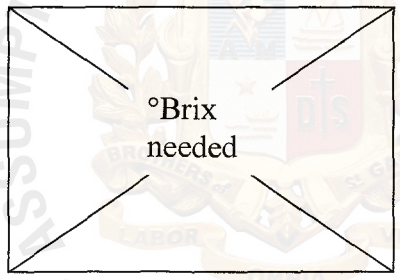
Calculate for sugar adding

- Calculate the sugar adding by using the Peason square method

Equipment: Refractometer
Calculator

Procedure:

Measure the °Brix of banana fix soak in the water then put it in the square and calculate as shown below.



$$\frac{\text{°Brix needed} - \text{°Brix of sample}}{\text{°Brix of sugar source} - \text{°Brix needed}} \times \text{Total amount needed} = \text{Amount added}$$

APPENDIX B

Analysis method

1. Measure °Brix by use refractometer

This method is determined by measuring the refractive index of the solution. Refractometer should not be used for balling analysis, as samples containing alcohol will distort the refraction.

Apparatus: Refractometer
Bright light source

Procedure:

1. Adjust juice sample to room temperature or to that required by operating instructions of the instrument.
2. Open prism cover and rinse prism surface with several drops of sample. Gently wipe dry with absorbent lens paper.
3. Apply several drops of sample again and close prism cover. Point refractometer toward bright light source and hold in the same manner as a telescope. Adjust focus and read °Brix at light-dark dividing line. Record result.
4. Rinse refractometer prism surface and prism cover three times with distilled or deionized water and wipe dry with absorbent lens paper. Avoid scratching prism surface.

2. Alcohol determination by Ebulliometer

This analytical method should not be used for wines which have alcohol content greater that 14% by volume, or for wines which have a Balling of more than 0.0°. The rational of the Ebulliometer is to compare the boiling point of water with the boiling point of a wine sample, the difference being due to the alcohol content in the wine. In that the boiling point of water ranges from about 99°C to 101°C from day to day, in response to recheck the boiling point of water in the Ebulliometer every hour or so.

Apparatus: Salleron-DuJardin Ebulliometer with thermometer and circular slide scale
100-ml graduated cylinder
Distilled or deionized water
Cold tap water

Procedure:

1. Rinse all inside surface of the Ebulliometer with distilled or deionized water. Drain valve and close.
2. Fill upper reflux condenser jacket with cold tap water.
3. Measure 50 ml of distilled or dionized water into a clean 100 ml graduated cylinder and carefully pour into lower chamber inlet.
4. Very carefully insert thermometer into lower chamber inlet, holding rubber stopper portion in the other hand. Slowly and gently twist rubber stopper into position for a snug fit. These thermometers are very delicate and break rather easily.
5. Ignite ethanol burner and carefully position under lower chamber in the proper position.
6. Observe thermometer mercury rising until it stops and holds for 15-20 s at the same temperature. Remove ethanol burner and close carefully to extinguish flame.

7. Remove thermometer carefully in reverse manner to Step 4 above. Hold in vertical position until the mercury drops from the capillary. Dry with towel carefully and place upright in a save place.
8. Adjust circular slide scale to indicate the boiling point temperature of the water.
9. Empty the Ebulliometer carefully and rinse inner surfaces with a few ml of the wine sample to be analyzed. Drain the instrument and fill upper reflux condenser with cold tap water. Ensure that no water goes down the inner tube.
10. Rinse the 100-ml graduate with a few ml of the wine sample to be analyzed. Empty and refill with 50 ml of the wine.
11. Repeat Step 4-7.
12. Compare reading of the thermometer to corresponding alcohol percentage on the circular slide scale. For example, with water boiling at 99.8°C and a wine boiling at 91.1°C, the alcohol would be 12.1% by volume.

3. Total acidity

This analysis measures the unknown concentration of all wine acids by neutralizing those acids with a known concentration of basic (alkaline) reagent.

Apparatus: 10-ml volumetric pipette
250-ml wide-mouth Erlenmeyer flask
25-ml (in 0.1-ml gradations) burette with stopcock

Chemical: 1/10 N sodium hydroxide reagent
1% phenolphthalein indicator solution
Distilled or deionized water

Procedure:

1. If the sample has been taken from a freshly pressed lot of juice or must, there may be too many suspended solids for the pipette to allow through the narrow capillary at the tip. In this case, the juice sample temple should be carefully centrifuged or filtered through neutral paper. Adjust sample temperature to 68°F or to whatever temperature is indicated on the 10-ml volumetric pipette.
2. Pipette the 10-ml sample into clean 250 ml wide-mouth Erlenmeyer flask and add 5 drops of 1% phenolphthalein indicator into sample.
3. Fill burette with 1/10 N sodium hydroxide reagent and slowly drain down to the 0.0 starting point. Ensure that there is no air remaining in the outlet capillary.
4. Titrate carefully drop-by-drop until the slight pink color from the indicator turns pink (green for red wine) and holds for at least 15 s. Note burette reading for ml of 1/10 N sodium hydroxide used.
5. g/100ml total acidity is found by using the total acidity table (table B-1).

Table B-1: total acidity table (g/100 ml expressed as tartaric acid)

1/10 N NaOH	g/100 ml T.A.	1/10 N NaOH	g/100 ml T.A.	1/10 N NaOH	g/100 ml T.A.	1/10 N NaOH	g/100 ml T.A.
5.1	0.383	8.1	0.608	11.1	0.833	14.1	1.058
5.2	0.390	8.2	0.615	11.2	0.840	14.2	1.065
5.3	0.398	8.3	0.623	11.3	0.848	14.3	1.073
5.4	0.405	8.4	0.630	11.4	0.855	14.4	1.080
5.5	0.413	8.5	0.638	11.5	0.863	14.5	1.088
5.6	0.420	8.6	0.645	11.6	0.870	14.6	1.096
5.7	0.428	8.7	0.653	11.7	0.878	14.7	1.103
5.8	0.435	8.8	0.660	11.8	0.885	14.8	1.110
5.9	0.443	8.9	0.668	11.9	0.893	14.9	1.118
6.0	0.450	9.0	0.675	12.0	0.900	15.0	1.125
6.1	0.458	9.1	0.683	12.1	0.908	15.1	1.133
6.2	0.465	9.2	0.690	12.2	0.915	15.2	1.140
6.3	0.473	9.3	0.698	12.3	0.923	15.3	1.148
6.4	0.480	9.4	0.705	12.4	0.930	15.4	1.155
6.5	0.488	9.5	0.713	12.5	0.938	15.5	1.163
6.6	0.495	9.6	0.720	12.6	0.945	15.6	1.170
6.7	0.503	9.7	0.728	12.7	0.953	15.7	1.178
6.8	0.510	9.8	0.735	12.8	0.960	15.8	1.185
6.9	0.518	9.9	0.743	12.9	0.968	15.9	1.193
7.0	0.525	10.0	0.750	13.0	0.975	16.0	1.200
7.1	0.533	10.1	0.758	13.1	0.983	16.1	1.208
7.2	0.540	10.2	0.765	13.2	0.990	16.2	1.215
7.3	0.548	10.3	0.773	13.3	0.998	16.3	1.223
7.4	0.555	10.4	0.780	13.4	1.005	16.4	1.230
7.5	0.563	10.5	0.788	13.5	1.013	16.5	1.238
7.6	0.570	10.6	0.795	13.6	1.020	16.6	1.245
7.7	0.578	10.7	0.803	13.7	1.028	16.7	1.253
7.8	0.585	10.8	0.810	13.8	1.035	16.8	1.260
7.9	0.593	10.9	0.818	13.9	1.043	16.9	1.268
8.0	0.600	11.0	0.825	14.0	1.050	17.0	1.275

4. Total sulfur dioxide

Each wine has some portion of the total amount of sulfur dioxide existing in combination with other wine components. This is called "bound" sulfur dioxide. The combination of bound and free SO_2 is called "total SO_2" and is limited to maximum of 350 ppm by ATF regulation. One of the most popular methods for determining total sulfur dioxide is by the following modified Ripper method.

Apparatus: 20-ml volumetric pipette
250-ml wide-mouth Erlenmeyer flask
Rubber stopper
25-ml (in 0.1-ml gradations) burette with stopcock

Chemical: 25% sodium hydroxide
25% sulfuric acid
1% starch solution
1/40 N iodine

Procedure:

1. Adjust sample temperature to 68°F, or to whatever temperature is indicated on 20-ml volumetric pipette.
2. Pipette the sample into clean 250-ml wide-mouth Erlenmeyer flask and add 5 ml of 25% sodium hydroxide. Seal with rubber stopper. Swirl for a few seconds and set aside for about 15 min.
3. Remove stopper; add 5 ml, of 25% sulfuric acid, a pinch of bicarbonate of soda, and 5 drops of 1% starch solution to sample in flask.
4. Titrate carefully with 1/40 N iodine from burette until color changes to light blue (blue-green in reds) and holds for at least 15 s. Note burette reading for ml of 1/40 N iodine used.
5. mg per liter (part per million) of free sulfur dioxide is found by using the sulfur dioxide table (table B-2).

Table B-2: sulfur dioxide table

Iodine ml	SO_2 ppm	Iodine ml	SO_2 ppm	Iodine ml	SO_2 ppm	Iodine ml	SO_2 ppm
0.1	4	2.1	84	4.1	164	6.1	244
0.2	8	2.2	88	4.2	168	6.2	248
0.3	12	2.3	92	4.3	172	6.3	252
0.4	16	2.4	96	4.4	176	6.4	256
0.5	20	2.5	100	4.5	180	6.5	260
0.6	24	2.6	104	4.6	184	6.6	264
0.7	28	2.7	108	4.7	188	6.7	268
0.8	32	2.8	112	4.8	192	6.8	272
0.9	36	2.9	116	4.9	196	6.9	276
1.0	40	3.0	120	5.0	200	7.0	280
1.1	44	3.1	124	5.1	204	7.1	284
1.2	48	3.2	128	5.2	208	7.2	288
1.3	52	3.3	132	5.3	212	7.3	292
1.4	56	3.4	136	5.4	216	7.4	296
1.5	60	3.5	140	5.5	220	7.5	300
1.6	64	3.6	144	5.6	224	7.6	304
1.7	68	3.7	148	5.7	228	7.7	308
1.8	72	3.8	152	5.8	232	7.8	312
1.9	76	3.9	156	5.9	236	7.9	316
2.0	80	4.0	160	6.0	240	8.0	320

5. Reducing sugar kit method

Apparatus: Glass tube

Chemical: Reducing sugar kit tablet

Procedure:

1. Collect sample in clean receptacle with dropper, place 5 drops of sample in test tube. Rinse dropper and add 10 drops of water in the test tube.
2. Drop 1 tablet into test tube. Watch while complete reaction takes place. Do not shake test tube during reaction nor for 15 s after boiling inside test tube has stopped.
3. At the end of 15 s waiting period, shake test tube gently, compare with color chart.

APENDIX C

Wine filtration

- Method for wine filtration

1. Prepare the diatomaceous earth by mixing a big spoon of diatomaceous earth with 1L of distilled water.
2. Put the filter paper on the surface, turn on the vacuum pump.
3. Turn off vacuum pump and pour water off from the flask.
4. Turn on vacuum pump and pour wine.
5. Filtrate turn to be clear.

APPENDIX D

Sensory analysis

Table D-1: tests of Between-Subjects Effects for dependent Variable: CLARITY

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7.057	21	.336	4.366	.000
Intercept	437.963	1	437.963	5690.314	.000
TRET	.324	7	4.635E-02	.602	.753
REP	6.732	14	.481	6.248	.000
Error	7.543	98	7.697E-02		
Total	452.563	120			
Corrected Total	14.599	119			

a R Squared = .483 (Adjusted R Squared = .373)

Table D-2: tests of Between-Subjects Effects for dependent Variable: COLOR

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	24.872	21	1.184	6.060	.000
Intercept	308.963	1	308.963	1580.897	.000
TRET	7.753	7	1.108	5.667	.000
REP	17.119	14	1.223	6.257	.000
Error	19.153	98	.195		
Total	352.988	120			
Corrected Total	44.025	119			

a R Squared = .565 (Adjusted R Squared = .472)

Table D-3: scheffe for COLOR

Scheffe

TRET	N	Subset	
		1	2
8.00	15	1.0067	
7.00	15	1.4300	1.4300
3.00	15		1.6667
4.00	15		1.6667
6.00	15		1.6833
1.00	15		1.7333
2.00	15		1.8000
5.00	15		1.8500
Sig.		.448	.460

Means for groups in homogeneous subsets are displayed. Based on Type III Sum of Squares The error term is Mean Square (Error) = .195.

a Uses Harmonic Mean Sample Size = 15.000.

b Alpha = .05.

Table D-4: tests of Between-Subjects Effects for dependent Variable: AROMA

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	11.722	21	.558	2.519	.001
Intercept	96.338	1	96.338	434.800	.000
TRET	1.790	7	.256	1.154	.336
REP	9.932	14	.709	3.202	.000
Error	21.714	98	.222		
Total	129.774	120			
Corrected Total	33.436	119			

a R Squared = .351 (Adjusted R Squared = .211)

Table D-5: tests of Between-Subjects Effects for dependent Variable: CONDITION

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	13.891	21	.661	5.864	.000
Intercept	70.825	1	70.825	627.872	.000
TRET	.571	7	8.157E-02	.723	.653
REP	13.320	14	.951	8.434	.000
Error	11.055	98	.113		
Total	95.770	120			
Corrected Total	24.945	119			

a R Squared = .557 (Adjusted R Squared = .462)

Table D-6: tests of Between-Subjects Effects for dependent Variable: DEVELOP

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	33.305	21	1.586	7.551	.000
Intercept	76.034	1	76.034	362.023	.000
TRET	.438	7	6.250E-02	.298	.953
REP	32.868	14	2.348	11.178	.000
Error	20.582	98	.210		
Total	129.921	120			
Corrected Total	53.887	119			

a R Squared = .618 (Adjusted R Squared = .536)

Table D-7: tests of Between-Subjects Effects for dependent Variable: QUALITY

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	16.262	21	.774	6.349	.000
Intercept	63.206	1	63.206	518.204	.000
TRET	.671	7	9.588E-02	.786	.601
REP	15.590	14	1.114	9.130	.000

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Error	11.953	98	.122		
Total	91.420	120			
Corrected Total	28.215	119			

a R Squared = .576 (Adjusted R Squared = .486)

Table D-8: tests of Between-Subjects Effects for dependent Variable: BODY

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	45.576	21	2.170	4.532	.000
Intercept	257.547	1	257.547	537.795	.000
TRET	5.843	7	.835	1.743	.108
REP	39.733	14	2.838	5.926	.000
Error	46.932	98	.479		
Total	350.055	120			
Corrected Total	92.508	119			

a R Squared = .493 (Adjusted R Squared = .384)

Table D-9: tests of Between-Subjects Effects for dependent variable: FLAVOR

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	33.939	21	1.616	3.206	.000
Intercept	227.288	1	227.288	450.890	.000
TRET	5.324	7	.761	1.509	.173
REP	28.615	14	2.044	4.055	.000
Error	49.401	98	.504		
Total	310.627	120			
Corrected Total	83.340	119			

a R Squared = .407 (Adjusted R Squared = .280)

Table D-10: tests of Between-Subjects Effects for dependent variable: BALANCE

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	45.765	21	2.179	3.597	.000
Intercept	189.505	1	189.505	312.813	.000
TRET	3.391	7	.484	.800	.590
REP	42.375	14	3.027	4.996	.000
Error	59.369	98	.606		
Total	294.640	120			
Corrected Total	105.135	119			

a R Squared = .435 (Adjusted R Squared = .314)

Table D-11: tests of Between-Subjects Effects for dependent variable: FINISHED

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	45.904	21	2.186	4.918	.000
Intercept	175.088	1	175.088	393.946	.000
TRET	7.329	7	1.047	2.356	.029
REP	38.575	14	2.755	6.200	.000
Error	43.556	98	.444		
Total	264.547	120			
Corrected Total	89.460	119			

a R Squared = .513 (Adjusted R Squared = .409)

Table D-12: tests of Between-Subjects Effects for dependent variable: EXCEPT

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	25.182	21	1.199	3.522	.000
Intercept	84.756	1	84.756	248.914	.000
TRET	6.698	7	.957	2.810	.010
REP	18.484	14	1.320	3.878	.000

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Error	33.369	98	.341		
Total	143.308	120			
Corrected Total	58.551	119			

a R Squared = .430 (Adjusted R Squared = .308)

Table D-13: raw data for SPSS calculation

Tret	Rep	Clarity	Color	Aroma	Condition	Develop	Quality	Body	Flavor	Balance	Finished	Except
1	1	2.00	2.00	.50	.50	.50	.50	.50	1.00	1.00	.50	.00
1	2	2.00	2.00	1.00	1.00	.50	1.00	1.50	1.00	1.00	1.00	.50
1	3	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1	4	2.00	1.00	1.50	1.00	1.50	1.00	.50	.50	.50	.50	.00
1	5	2.00	2.00	1.00	1.00	1.00	1.00	4.00	1.00	4.00	1.00	.00
1	6	1.00	1.00	2.00	.50	.50	.50	2.00	1.00	1.00	.50	1.00
1	7	2.00	2.00	.30	1.00	.20	.10	2.00	.10	.20	.20	.00
1	8	2.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	1.00	2.00
1	9	2.00	2.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	2.00	2.00
1	10	2.00	1.00	1.00	1.00	.00	.00	1.50	1.00	1.00	.50	.50
1	11	2.00	2.00	.50	.50	1.00	.50	1.50	1.00	2.00	1.00	.50
1	12	1.00	2.00	1.50	1.00	.50	1.00	2.00	1.50	2.00	2.00	1.50
1	13	2.00	2.00	1.00	.00	3.00	.00	.00	.00	.00	.00	.00
1	14	2.00	2.00	2.00	.00	1.00	1.00	1.00	2.00	3.00	2.00	2.00
1	15	2.00	2.00	2.00	.00	1.00	1.00	.00	1.00	1.00	1.00	.00
2	1	2.00	2.00	1.00	1.00	1.00	1.00	.50	1.00	1.00	.50	.00
2	2	2.00	2.00	1.00	.50	.50	.50	1.50	1.00	1.00	1.00	.50
2	3	2.00	2.00	.00	2.00	1.00	.00	1.00	1.00	1.00	1.00	1.00
2	4	2.00	2.00	1.00	1.00	1.00	1.00	2.00	2.00	.50	.50	1.00
2	5	2.00	2.00	2.00	.00	1.00	1.00	1.00	2.00	4.00	3.00	1.00
2	6	1.00	1.00	.67	.50	.50	.50	2.00	1.25	1.00	1.00	1.00
2	7	2.00	1.00	.50	1.00	.30	.10	1.00	1.00	.20	.30	.00
2	8	2.00	2.00	1.00	1.00	.00	1.00	1.00	2.00	1.00	1.00	1.00
2	9	2.00	2.00	1.00	1.00	1.00	1.00	3.00	2.00	2.00	2.00	2.00
2	10	2.00	1.00	1.00	1.00	.00	.00	1.50	1.00	1.00	.50	.50
2	11	2.00	2.00	.50	.50	.50	.50	2.00	1.00	2.00	1.50	.50
2	12	2.00	2.00	1.00	.00	.50	1.00	1.00	1.00	1.00	1.00	.20
2	13	2.00	2.00	1.00	.00	3.00	.00	.00	.00	.00	.00	.00
2	14	1.00	3.00	1.00	.00	1.00	1.00	2.00	1.00	1.00	2.00	2.00
2	15	2.00	1.00	.00	1.00	.00	1.00	1.00	3.00	1.00	1.00	.00
3	1	2.00	2.00	1.00	1.00	1.00	1.00	.50	1.00	1.00	.50	.00
3	2	2.00	2.00	1.00	.50	.50	.50	1.00	1.00	1.00	1.00	.50
3	3	2.00	2.00	1.00	1.00	.00	.00	1.00	1.00	1.00	1.00	1.00
3	4	2.00	2.00	1.00	1.00	1.00	1.00	2.00	2.00	.50	.50	1.00
3	5	3.00	1.00	.00	1.00	2.00	1.00	5.00	2.00	1.00	2.00	1.00
3	6	1.00	1.00	.63	.50	.50	.50	2.25	1.50	1.00	1.00	1.25
3	7	2.00	1.00	.20	1.00	.20	.40	1.00	1.20	.20	.10	.00

Tret	Rep	Clarity	Color	Aroma	Condition	Develop	Quality	Body	Flavor	Balance	Finished	Except
3	8	2.00	2.00	1.00	1.00	.00	1.00	1.00	2.00	1.00	1.00	1.00
3	9	2.00	2.00	1.00	1.00	1.00	1.00	2.00	3.00	2.00	2.00	2.00
3	10	2.00	1.00	1.00	1.00	.00	.00	1.50	.50	1.00	.50	.50
3	11	2.00	2.00	.50	.50	1.00	.50	2.00	1.00	2.00	1.50	1.00
3	12	2.00	2.00	1.00	1.00	1.00	1.00	.50	.50	2.00	2.00	.20
3	13	2.00	2.00	1.00	.00	3.00	.00	.00	.00	.00	.00	.00
3	14	2.00	2.00	1.00	.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00
3	15	2.00	1.00	2.00	.00	.00	2.00	2.00	2.00	1.00	2.00	1.00
4	1	2.00	2.00	1.00	1.00	1.00	1.00	.50	1.00	1.00	.50	1.00
4	2	2.00	2.00	1.00	1.00	.50	1.00	2.00	1.00	1.50	1.50	1.50
4	3	2.00	2.00	.00	2.00	1.00	1.00	2.00	2.00	1.00	1.00	2.00
4	4	2.00	1.00	1.50	.50	1.00	1.00	2.50	2.50	2.50	2.00	2.00
4	5	2.00	2.00	1.00	1.00	.00	2.00	3.00	3.00	2.00	2.00	1.00
4	6	1.25	1.00	.63	.50	.50	.50	2.00	1.25	1.00	1.25	1.00
4	7	2.00	.50	.10	1.00	.10	.00	.30	1.30	.50	.30	.00
4	8	2.00	2.00	1.00	1.00	.50	.50	2.00	2.00	1.00	1.00	1.00
4	9	2.00	2.00	2.00	.50	.50	1.00	2.00	2.00	2.00	2.00	2.00
4	10	2.00	1.00	.50	1.00	.00	.00	1.50	.50	1.00	.50	.50
4	11	2.00	2.00	.50	.50	1.00	.50	2.00	1.00	2.00	1.50	1.00
4	12	1.50	2.50	2.00	1.00	.50	.50	2.00	5.00	1.00	2.00	.20
4	13	2.00	2.00	.00	.00	3.00	.00	.00	.00	.00	2.00	.00
4	14	2.00	2.00	2.00	.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4	15	2.00	1.00	1.00	.00	.00	2.00	3.00	2.00	2.00	3.00	2.00
5	1	2.00	2.00	1.00	.50	1.00	1.00	1.00	1.00	1.00	.50	1.00
5	2	2.00	2.00	1.00	1.00	1.00	1.00	2.00	1.50	1.50	1.50	1.50
5	3	2.00	2.00	1.00	2.00	.00	.00	2.00	1.00	1.00	.00	1.00
5	4	2.00	2.00	1.00	1.00	1.00	1.00	1.50	1.50	.50	.50	.50
5	5	2.00	2.00	1.00	2.00	1.00	1.00	2.00	1.00	1.00	5.00	2.00
5	6	1.00	1.25	.63	.50	.50	.50	2.25	1.25	1.00	1.00	1.50
5	7	2.00	1.00	.20	1.00	.20	.20	2.00	.20	.10	.20	.00
5	8	2.00	2.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00
5	9	2.00	2.00	1.00	1.00	1.00	1.00	3.00	3.00	2.00	2.00	2.00
5	10	2.00	1.00	1.00	1.00	1.00	.00	1.50	1.00	1.00	.50	.50
5	11	2.00	2.00	.50	.50	1.00	.50	2.50	2.00	2.00	1.50	1.50
5	12	1.50	2.50	2.00	1.00	.50	.50	2.00	2.00	1.00	5.00	2.00
5	13	2.00	2.00	1.00	.00	1.00	2.00	1.00	2.00	5.00	2.00	2.00
5	14	2.00	2.00	1.00	.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00
5	15	2.00	2.00	1.00	1.00	.00	2.00	2.00	4.00	2.00	2.00	2.00
6	1	2.00	2.00	.50	.50	1.00	1.00	.50	1.00	.50	.50	.00
6	2	2.00	2.00	1.00	.50	.50	1.00	1.00	1.00	1.00	1.00	.50
6	3	2.00	2.00	1.00	1.00	.00	.00	1.00	2.00	.00	.00	.00
6	4	2.00	1.00	1.00	1.00	1.00	1.00	.50	.50	.50	.50	.00
6	5	3.00	1.00	.00	1.00	2.00	1.00	2.00	3.00	3.00	2.00	1.00
6	6	1.00	1.25	.63	.50	.50	.50	2.00	1.50	1.00	1.25	1.25
6	7	2.00	2.00	.10	1.00	.20	.30	.20	1.00	.50	.80	2.00
6	8	2.00	2.00	.50	1.00	1.00	1.00	2.00	2.00	2.00	2.00	1.00
6	9	2.00	2.00	1.00	1.00	1.00	1.00	3.00	3.00	2.00	2.00	2.00
6	10	2.00	1.00	1.00	1.00	1.00	.50	2.00	2.00	2.00	2.00	1.50
6	11	2.00	2.00	.50	.50	.50	.50	1.50	1.00	2.00	1.00	.50

Tret	Rep	Clarity	Color	Aroma	Condition	Develop	Quality	Body	Flavor	Balance	Finished	Except
6	12	2.00	2.00	.50	1.00	1.00	1.00	1.00	1.00	1.00	2.00	1.50
6	13	2.00	2.00	2.00	1.00	.50	1.00	2.00	2.00	3.00	3.00	1.50
6	14	1.00	2.00	2.00	.00	1.00	1.00	2.00	1.00	1.00	1.00	.00
6	15	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	1.00
7	1	2.00	1.00	.50	.50	.50	.50	.00	1.00	.50	.50	.00
7	2	2.00	2.00	1.00	.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7	3	2.00	2.00	1.00	1.00	1.00	1.00	1.00	2.00	.00	.00	.00
7	4	1.00	1.00	1.50	.50	1.00	1.00	2.00	2.00	.50	.50	1.00
7	5	3.00	1.00	1.00	1.00	2.00	.00	3.00	3.00	3.00	1.00	.00
7	6	1.50	1.25	.50	.67	.50	.67	2.00	1.50	1.00	1.25	1.75
7	7	2.00	.20	.20	1.00	.30	.30	.20	.50	.50	1.20	.00
7	8	2.00	2.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	2.00	1.00
7	9	2.00	2.00	1.00	1.00	1.00	1.00	3.00	1.00	2.00	2.00	2.00
7	10	2.00	1.00	.50	1.00	.00	.00	1.50	.50	1.00	.50	.50
7	11	2.00	1.00	.35	.35	.35	.35	1.50	1.00	1.00	1.00	.50
7	12	2.00	2.00	1.00	2.00	.00	.50	1.00	1.00	1.00	2.00	1.50
7	13	2.00	2.00	.00	.00	3.00	.00	.00	.00	.00	2.00	.00
7	14	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.00
7	15	2.00	1.00	.00	1.00	.00	1.00	.00	.00	1.00	1.00	.00
8	1	2.00	1.00	1.00	.50	.50	1.00	.00	1.00	.50	.50	.00
8	2	2.00	1.00	1.00	1.00	.50	.50	1.00	1.50	1.00	1.00	1.00
8	3	2.00	1.00	1.00	1.00	.00	.00	.00	2.00	.00	.00	.00
8	4	1.00	1.00	.50	1.00	.50	1.00	1.50	1.50	.50	.50	.00
8	5	1.00	3.00	.00	1.00	1.00	2.00	1.00	2.00	5.00	1.00	.00
8	6	1.50	1.50	1.00	.67	.67	.67	2.00	1.50	1.00	1.50	1.50
8	7	2.00	.10	.40	1.00	.00	.00	.10	.10	.10	.10	.00
8	8	2.00	2.00	1.00	1.00	1.00	.50	1.00	2.00	2.00	2.00	1.00
8	9	2.00	2.00	.50	1.50	1.00	1.00	1.00	.50	1.00	1.00	1.00
8	10	2.00	.00	.00	1.00	1.00	.00	1.00	.50	.50	.50	.50
8	11	2.00	.50	1.00	.50	1.00	.50	1.00	1.00	1.00	1.00	.50
8	12	2.00	.00	2.00	.50	.50	1.00	2.00	2.00	1.50	2.00	1.00
8	13	2.00	1.00	.00	.00	3.00	.00	2.00	1.00	2.00	1.00	.50
8	14	2.00	1.00	1.00	.00	1.00	1.00	1.00	.00	.00	.00	.00

APPENDIX E

Sensory evaluation test (20-point system)

Date: _____
Test panelist: _____

- Please rinse your mouth before staring.
- Evaluate the product in front of you looking at it and tasting it
- **Considering All characteristics (APPEARANCE, NOSE AND BOUQUET, PALATE AND EXCEPTIONAL CHARACTERISTIC) indicated your overall opinion by giving mark in the provided box.**

Definitions:
Appearance: how does the wine look?
Nose (also bouquet): how does the wine smell?
Palate: how does the wine taste and feel in your mouth?
Exceptional qualities: catchall phrase for any perceptions of excellence or unusual worth above and beyond the sensorial inputs. This is the place to note for future reference.
Condition: clean or unclean? (Sulfur or oxidation or musty?)
Development: immature or ripe?
Body: feel of wine in your tongue and mouth
Balance: if any flavor component overpowers the overall balance of the wine is off and it loses points.
Finish: aftertaste

Sample: dry banana wine

Attribute	Sub attribute	WS1	WS2	WS3	WS4	WS5	WS6	WS7	WS8
Appearance (Total points 4)	Clarity								
	Color								
Nose and bouquet (Total points 4)	Aroma								
	Condition								
	Development								
	Quality								
Palate (Total points 10)	Body								
	Flavor								
	Balance								
	Finish								
Exceptional characteristics (Total points 2)	-								

Remark: the mark, which is given in each sub attribute, must have the total point equal to the total point of that attribute when combine.

Comment:

_____

_____