PRODUCTION OF WINE FROM LOCAL FRUITS

(APPLE, PINEAPPLE AND ORANGE)

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DECLARATION

I, Daniel Meshach Ahyuwa (2001/11511EH) hereby declare that this research work was done by me under the supervision of Engr. O.S. Azeez of the Department of Chemical Engineering during the 2006/2007 academic session of the Federal University of Technology, Minna, Niger State.

.....
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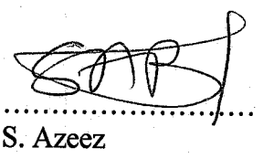
CERTIFICATION

This is to certify that this research work was done by Daniel Meshach Ahyuwa(2001/11511EH) under the supervision of Engr. O. S. Azeez in partial fulfillment of the requirement for the award of Bachelor of Engineering (B.Eng.) in the Department of Chemical Engineering of the Federal University of Minna, Niger State, Nigeria.



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DEDICATION

This research project is dedicated to God almighty who by his special grace upon me made the success of this work a reality. I also dedicate this work to my Dad and Mum, Mr. and Mrs. Elisha K. Daniel for their support, prayers and inspiration, I can only but thank you.

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I will firstly like to give all praise to God almighty for his mercies, guidance and provision and also for sparing my life to achieve this feat right from 100 level to this day. Lord may your name be glorified.

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I also acknowledge the support of all my extended family members who supported me in one way or the other, I also want to acknowledge the support of Mr. and Mrs Emmanuel Joab, Mr.and Mrs. Solomon Waje, all the members of Victory Baptist Church and Babel Baptist Church, may the Lord bless them all.

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ABSTRACT

The wine was extracted from edible tropical fruits (apple, pineapple and orange). The extraction was conducted by mixing the fruits, adding preservatives and yeast, allowing the mixture to ferment at 25°C for a week, then sieve, with time the product became much more clear, had a better taste and the odour reduced.

The wine produced with the same quantity of fruits had a pH value of 6.6 which is acidic, a brix value of 13.64 and a refractive index of 1.334 as read from the refractometer. The alcoholic content was calculated to be 7.502.

The wine produced using different quantities of fruit had a pH value of 6.4 as gotten from an electronic pH meter, a brix value and refractive index of 13.9 and 1.350 respectively and a calculated alcoholic content of 7.645

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CHAPTER ONE

INTRODUCTION

1.1 GENERAL INTRODUCTION

Wine is essentially the product of fermentation of sugar of juice of grape by yeast sacharomyces cerevisale ellipsodeus to form alcohol and carbon dioxide in broad definition it is an alcoholic beverage made by the fermentation of the juice of other agricultural produce.

Where a wine is made from a substrate other than grape, such a wine carries the name of the substrate from which it is made, as apple-wine, mango wine, orange wine, pineapple wine and cashew wine.

Kunkee and Goswell gave the number of compounds found in wine about 400, some of these compounds include, esters, fuse oils (higher alcohol) fixed acids (tartaric, maleic and citric acids) sugars, aldehydes tannin and pectins.

Food in addition to air and water has from time immemorial been the most important requirement for the support of life. Food supplies the body with nutrients such as protein, vitamins, carbohydrates and fats, which are required for normal functioning and maintenance of the human beings.

Based on the classification of food, wine contains vitamins and wine is found in the diet of many people.

Wine is considered to be the oldest fermented alcoholic beverage. Grape ferments naturally because they contain all the essential ingredients namely, sugar, water and yeast. The first two being present in the juice and the yeast is present on the skin.

The high cost of grape fruits however has been the major problem in the wire industry. Nigeria is presently passing through a developmental stage in which there

is a strong emphasis on local sourcing of raw materials and this awareness has transformed into a general interest at commercial processing of indigenous local food. This has therefore necessitated the use of local and cheap fruits such as pineapple,

mango, orange and apple in the production of bottled fruit wine as part of the effort to enhance the economy.

1.2 AIMS AND OBJECTIVES

The topic of this research work is production of wire from local fruits (apple, pineapple and orange). The work aims at the successful production of wine from local fruits and is focused at the development of small scale industry for the production of wine, which can make young chemical engineers self employed and also create job opportunities for other citizens, thereby contributing to the reform of our degenerated economy.

The scope of this research project covers the fermentation of fruits to produce wine at a temperature of 23°c to 28°c for a period of seven days, using the same quantity of fruit for the first run and varying the quantity of fruit for the second run, then compare the values gotten with standard values to see which has a better yield.

CHAPTER TWO

LITERATURE REVIEW

2.1 HISTORY OF WINES

It is believed that the making of wine originated under mount Arafat on the southern slopes of the Caucus Mountains flanked by the Caspian and black seas, where cultivation of wine first flourished. The craft spread southwest to the share of the black sea. The Assyrians made much of the innovation. The Babylonian king Nebuchadnezzar became the owner of the wine yards and wine cellars. There is even a wine list dating from that time in existence today. The Assyrians carried the craft down along the Lebanese coast and beyond to Palestine and round the Mediterranean elbow of Egypt.

From the scant evidence it seemed that red wine was very common in ancient Egypt, white wine is first securely attested in the third century AD. In the tomb of Tutankhamen, wine jars were found with the inscription irp nDm "sweet wine" partly dried grapes, (because they contain concentrated sugar) were used for producing sweet wine. "Blended wine" (irp SmA) appears on labels found at Malgata. It is not certain whether wine of different years, vineyards or types were mixed. Other wines mentioned in Egyptian texts were made from sweet fruits such as dates and fig. The Egyptian pharaoh was especially fond of wine which is being is being enjoyed for years by man, from peasants to kings. Some of them were even buried with bottles of wine, in order to make their journey to the underworld more tolerable. Wine was a very social drink in ancient Egypt and great importance was given to its production and consumption.

The Egyptians were not the first to grow wine, but they were the first to record the process of wine making and celebrate its values.

The early Greeks use wine as medicine and today, it is believed that wine can aid digestion and help relieve tension. Wines are used to compliment meal and to celebrate joyful activities occasions, they are also used in serving various dishes.

Wines can be classified according to country area, Variety of grapes used, colour and the degree of sweetness, that most people who produce wine divide them into six (6)

main classes, according to when the wines are generally served. The most famous countries involved in wine production includes France, Germany, Italy and the united states. Wine from France rank among the first independent in their qualities and variety. They produce chiefly red, white and champagne wines which has a generic name Burgundy and Chablis.

A wine that has generic name does not necessarily resemble the wine from the region for which it was named because of this reason, wine produced in the united states and some other countries use varietal names for their best wine. A varietal name to the name of the principal fruit used to make the wine, example of such include dubonnet, sourignon, chorchlonnay, blank and pinst niov.

However, apart from the class of wine and such classification are usually considered only on guild.

2.2 TYPES OF WINE

Wines can be classified under six main classes as follows:-

1. Appetizer wines
2. White table wine
3. Desert wines
4. Sparkling wines
5. Red table wines
6. Other wines

2.2.1 APPETIZER WINES

Apentifs are flavored for before – meal uses are served with appetizers. Sherry, the most popular is characterized by its "Nutty" flavor. Most Sherries have in alcoholic content 17-20 percent (%) of volume. Vermouth is another favorite as is Dubonnet. They are aromatic wines flavored by the steeping in them of herbs and other aromatic substances or by the addition of an infusion substance of herbs. Aromatic wines are frequently used as mixers. Dry and pale vermouth (French type) is used extensively for cocktails, sweet

and dark amber-vermouth (Italian type) for Manhattans, and Dubonnet for Dusbonet Cocktails. These wines range from 15 to 20 percent (%) in alcoholic content.

2.2.2 WHITE TABLE WINES

White table wines vary from extremely dry and tart to sweet and mellow, with delicate flavor and by tradition are consumed with white meat, fowl and sea foods. They range in colour from pale stow to deep gold and in alcohol content from 10 to 14 percent (%). The still wines consumed in the country come principally from France, Germany and Italy or are native to the United States.

2.2.3 RED TABLE WINES

Red table wines are usually dry, rich, sometimes tart and even astringent in flavor; they are traditionally consumed with red meats, pastas, and highly seasoned foods. Their alcohol content ordinarily runs from 10 to 14 percent (%) by volume (pink or rose are normally produced by leaving grape skins in the juice for only a fraction of the fermentation time). Red table wines come principally from France and Italy or are native in the United States.

2.2.4 DESERT WINES

Desert wine are used chiefly after meals, are still wines containing generally over 14 percent (%) and less than 21 percent (%) alcohol. The name has legal significance. In

many countries all wines of more than 14 percent (%) alcohol are grouped together for purposes, usually as “desert wines”.

Table wines or wines with alcohol content not cover 14 percent (%), are taxed at lower rates for legal purposes, and to some extent are used as well, appetizer wines such as sherries and vermouth come under the desert wines, such as those from sentences and Barsac, France, more typical of desert wines are ports (both red white). Madeira, Marsalis, Malaga, Muscatel, to Kay, which generally contain around 20 percent (%) alcohol content.

2.2.5 SPARKLING WINES

Are table wines that have been made naturally effervescent by a second fermentation in closed containers. They are white, pink or red with a wide range of flavor characteristics and varying degrees of dryness or sweetness. Their usual alcoholic content is 10 to 14 percent (%) by volume, followed by sparkling burgundy. Moseley, rose and ash spumanter. They are called sparkling they contain a visible excess of CO_2.

2.2.6 OTHER WINES

Apart from making wines from grapes, wine can be made from fruits such as tamerine, mangoes, apples, peas, barriers cashew, etc where the wine is made from a substrate other than grape such a wine carries the name of the substrate from which it was made, hence names such as apple wine, orange wine, mango wine, pineapple wine. Kunkee and Goswell gave the number of components in wines at about 400. Some of these components include Estes, Fuse oils (higher alcohols). Fixed acids, (tartaric, maleic and citric acids). Sugars, aldelydes, tannin and pectins. Wines are commonly found in the diet of many people and are sources of vitamin C, sugar and minerals. Fruits are abundantly available globally and can be used by a number of micro-organisms.

2.3 COMPOSITION OF WINES

The compositions of wines vary with types of wine as well as the sugar content. For example dry wines are those with less sugar content and contain 0.2% sugar, sweet wines up to about 6%. Also of importance is the pH during storage and fermentation which has to be considered. Most wines have a total acidity (as acetic – acid) from 0.3 – 0.55% and volatile acidity (as acetic acid) from 0.35%. More also vinegar tastes in wine desirable poor quality and units of 0.12% for white wine and 0.14% for red table wines (expressed as acetic acid). In addition to acetic and other acids, ethyl acetate is properly an important contributor to spoilage. Also water holding capacity of the soil strongly affects the final flavor of the wine.

2.4 CHARACTERISTICS OF WINE

Depending on climate the grapes have these characteristics

Warm Climates	Cool Climates
1. High sugar	1.Low sugar
2. Low acidity	2. High acidity
3. Low colour	3. High colour
4. Low flavor	4. High flavor
5. High yield	5. Low yields

2.5 BASIC RAW MATERIAL FOR WINE PRODUCTION

The best wine has to be produced from grapes. This is because grapes contain better balance of sugar, acid, tanning and juice than any other fruit. Experience has shown this over centuries, although not all verities of grapes are equally suitable, many

other ingredients can be used to make attractive and different wines. The following are basic ingredients use:

(i) Grape

(ii) Sugar

(iii) Yeast

(iv) Nutrient

(v) Acid blend

(vi) Fining

(viii) Antioxidant

2.5.1 GRAPE

This is the basic raw material used for wine making due to its relative sweetness, which on fermentation yield adequate alcoholic content. Proper making of grapes depends on what wine they will be used for. For most wine, optimum sugar and acid

content can be established based on the wine makers experience for the particular vineyard and wine type. Grape is juicy but low in acidity.

2.5.2 SUGAR

Sugar is one of the most important measures in wine making; this is because it gives wine its optimum alcohol content. Depending on the variety of concentrate used, about 1.5 to 3.0 ponds of sugar is needed. It is also fundamentally important because it is the most essential wine components; ethyl alcohol is derived from the fermentation of sugars. Corn sugar is recommended for wine making because it gives a faster fermentation and seems to make a slightly smoother wine. Ordinary household sugar can also be used.

2.5.3 YEAST

Yeast is a living thing and is added to the wine at a set time to cause fermentation. It is important to use only true yeast for fermentation. Fast stating yeast is very important just as it is in beer brewing. Doormat yeast, if used can cause spoilage due to airborne molds and bacteria, fast yeast usually act within 12 hours after inoculation in the must. The common yeast used include; saccharomyce Calbogensis and saccharomce cerevisae. Wine yeast is available in both liquid and dried forms. The dried yeast is normally recommended because it usually begins fermenting much faster. It is packed in nitrogen sealed foil packs and maintains its freshness longer than the liquid during fermentation, the yeast multiply and this new yeast is collected and used for future wines.

2.5.4 ACID – BLEND

The word blend means combination of two or three things to form one. Acid – blend is the combination of the three fruit acids. That is the maleic, citric and tartaric acid and is necessary in wine to raise the level of the wine. The natural fruit acid and what gives wine. Its characteristics tart-taste. It should be of required amount if too low, the acid level of the wine will have an insipid flavor and when too high, the wine taste high.

2.5.5 FINING

This is a substance from the storage. These are several types of finings that include sparkoloid, gel and gelatin but sparkoloid has been found to be more effective. It is obtained in both powder and tablet form. Fining agent has also been employed to remove excess metals. It involves the use of potassium ferrycyanide, which removes copper and iron.

2.5.6 ANTIOXIDANT

This pure vitamin "C" ascorbic acid and is used in small quantities, whenever the wine is transferred or racked to another vessels and prior to bottling antioxidant prevents wine from being oxidized from contact with air. It is not required in the early stage of fermentation because the ongoing fermentation provides it own protection.

2.6 WINE PRODUCTION

Wine making has a single, uncomplicated procedure which if carefully followed will give or make a fine, perfectly balanced wine

Regardless of the type of concentrate used. The procedures of wine making are in steps as follows:

2.6.1 SORTING AND GRADING

The harvested fruits at their optimum maturity are sorted and graded according to the maturity, that is the ripe ones and sorting include separating the bad from the good ones, include those infected with any kind of disease such as botrytis infection which affects the flavor of wine or bruised fruit.

2.6.2 MUST PRODUCTION

After the necessary sorting and grading, the fruits are washed to remove further dirt and the fruit crushed, using a crusher-steams machine, which crushes fruits without the seed and removes the stems, water is then added to the crushed fruit (pulp to form what is called a "MUST". The must still containing the seeds and the skins is pumped into fermentation dark about 100 to 150 ppm of sulphur dioxide (So_2) gas. The gas

controls the growth of bacterial and wild yeast, whereas the various strains of wine yeast are adapted to this amount of So_2.

2.6.3 FERMENTATION

Pure starter yeast consisting of various strains of saccharomyces cerevisae is added to the must. The yeast occurs widely in nature on soils, on grapes and in wineries, unless unfavorable climate conditions occur during

Ripening. Sufficient members of desired yeast occur on the grapes to start fermentation as soon as the grapes are crushed. In the production of white wine, the juice is separated from the skin and seeds at an early stage of fermentation, often 48 hours. Temperature of 24-30°C is normally used. This temperature helps in the development of wine aroma and flavor.

2.6.4 BIOCHEMISTRY OF WINE FERMENTATION

Fermentation is metabolic processes that bring about the chemical changes in organic substrate through the action of enzymes of micro-organism or other cells. The term "fermentation" originally applied only to anaerobic contains such as Beer and wine production.

The overall equation for alcoholic fermentation of sugar which was converted later in molecular terms is as follows:-

$C_5H_{12}O_62C_2H0H+2CO_2$, the reaction stars from hexose (6-carbon) sugar being fermented and phosphorillated to triose (C- carbon). The triose units are converted actaldelycle which is then reduced to alcohol. The yield of alcohol is of obvious practiced importance to the wine water.

Wine produced after one or two days fermentation is light wine, several weeks are heavy wine and longer periods are wines that turn to vinegar.

2.6.5 CLARIFICATION

As the must get fermented, the product obtained is wine in a cloudy form (primarily with yeast cells), care and time are taken to remove the hazy (cloudiness) and

foul tasting liquid into a clear, pleasant and drinkable product. This process involves reducing the temperature; storage in various types of containers, racking, filtration, fining, centrifugation, refrigeration and other processes.

The main purpose of must and wine treatment are removal of suspended materials, off-taste and odour, off flavor. Removal of foreign toxic materials, residue fining agents, removal of substances which could later make the wine cloudy. Also to make must and wine filtrate as prevention measure against future undesirable changes.

2.6.6 AGEING

Ageing is one of the most complex and an important process in wine making. Newly fermented wine is cloudy, harsh in taste, yeasty in odour and without the pleasing, bouquet that develops later in its history. It is the process of keeping wine to get matured. As it aged properly, all these factors that is harsh taste of wine and yeastily odour diminish, leaving a mellow flavor and clear, odour free wine. The bouquet also develops during ageing. Wines are aged in Barrels, puncheons or Tanks. The tanks may be of wood, Concrete or metals. The principal changes in flavor and bouquet during ageing are generally believed to be due to slow oxidation. The average wine tank is not air-tight, but rather porous.

The ageing may last a few months to several years. However for ordinary quality wines, the small improvement in quality during ageing frequently does not justify the, the small improvement in quality during ageing frequently does not justify the longer ageing.

2.6.7 BOTTLING

In wine making bottling labeling and cashing is the least operation. Bottling is done to protect the wine against spoilage or deterioration by either oxygen or micro-organism and also present wine customers with dependable wines to also provide wine age to critical consumers. Cleanliness is highly required in this operation.

Bottles and corks are well cleaned and sterilized, new bottles are always used. The wine bottles are of many doing and sizes, this is because the bottle used for wine are carefully selected for sized strength, shape and freedom from defects. The strength of the bottle is of importance to prevent breakage by high speed during bottling, cooking and

capping. There are different types of filling machines which are commonly used for filling; these include siphon, vacuum, gravity and pressure. The filler must be kept scrupulously clean and are best sterilized with steam prior to use.

Automatic casing is necessary in large canneries. These are constructed so that bottles are glued and sealed shut.

2.7 QUALITY STANDARD IN WINES

The most important factors which affect the process of alcoholic fermentation and hence determine the quality of wine are as follows:

2.7.1 ACIDS

Little attention has been paid to the effects of organic acids on alcoholic fermentation of "must" if pH is very low 3.0 or lower, fermentation somewhat reduced. There are other effects of organic acids on alcoholic fermentation. The acids are however important in maintaining the pH low enough so as to inhibit the growth of many undesirable micro-organisms, thus giving a growth advantages to wine yeast.

2.7.2 CARBON SOURCE

Two principal sugars present in "must" are glucose and fructose, but most wine yeast ferment glucose more rapidly than they do the fructose, but saccharomyces elegans a yeast used in sauterne wine manufacture uses fructose more rapidly than glucose. The

fermentation of the carbohydrate. Naturally present in the "must" readily yields 11-12% alcohol. In cold Climates, especially in Eastern United States, where vitis labrusca grapes are grown for wine making. The wine may be fortified with sugar. Also if weather condition allows the grapes to mature quickly, water may be added to produce a wine of normal composition.

2.7.3 NITROGEN

Usually wine yeast does not synthesis their own needed amino-acid from ammonium ions or other simple nitrogen sources and sugar carbon. Most grapes "must" contain adequate nitrogen for 4 to 5 days fermentation. Except in very unusual cases, nitrogen addition to fermenting grape "must" is not necessary.

2.7.4 MINERALS

The normal cause of alcohol fermentation requires magnesium, potassium, zinc, cobalt, iodine, iron, calcium, copper and anions of phosphorus and sulphur. For growth yeast requires Cu, Fe, Mg, K P and sulphur.

2.7.5 TANNING

They are widely distributed polygenetic vegetable products of variable composition. When dissolved in water they from solution of astringent taste, when combined with ferric ions, they give blue black or green colours.

They are as well precipitated by proteins. They are mostly found in ask and hemlock bark and nut galls. Also about 3-6% of the skin of red grapes is tanning and they help stabilize wine colour. Tanning components vary widely in their antiseptic properties and naturally yeast may be quite sensitive to them, although wine state yeast is resistance to them.

2.7.6 SULPHUR DIOXIDE

Sulphur dioxide has since been used in the preservation stuff. It is also extensively in "must" to inhibit naturally grape yeast and bacteria, especially lactobacilli. Because from SO_2 has antiseptic properties, its protective power is reduced. If the "must" has a relatively high concentration of aldehydes.

Ketones and sugar which SO_2 will form bisulphate addition produces the antimicrobial efficiency of SO_2, is also affected by temperature, pH, pressure and type of microorganisms present SO_2, liquefied under pressure is now readily available and can be metered into the "must" to the desired level.

2.7.7 TEMPERATURE

Most wine yeast grow best at temperature of 27-30°F, but may grow at lower temperature and can ferment "must" at 20^0C or below. Long-slow fermentation at low temperature produces wines with flavor better than rapid fermentation at high temperature produce. Common temperatures for which wine is 17-18°C in sparking wine and 21-27°C in red wine. Because tanning and pigment substance has to be released from the skin.

Ethanol produced by the yeast will inhibit the cells. The degree of inhibition increase as the temperature rises. The lower the temperature, the higher the yield of alcohol, because fermentation is more complete and less alcohol is less by evaporation and to transport substance in escaping carbon-dioxide or entrain in escaping carbon-dioxide.

2.8 SPOILAGE OF WINE

2.8.1 MICROBIOLOGICAL

The spoilage of wine microbiological is connected with the initial contamination of the fruit substrate. The bulk of those microorganisms eliminated during the fermentation process. The contamination is first from the natural flora as well as from the soil to suppress this organism, the wine maker adds SO_2 to pasteurize the "must". Wine defects are mainly from metal or their salts, enzymes and sediments such as combined iron compounds. Wine undergoes spoilage microbially by the action of bacteria and yeast with condition mycodema being the most important yeast. Growth of this organisms attack alcohol and other constituents from this layer and create an appearance that is sometimes referred to as wine flower". Among the bacteria that cause wine spoilage are members of the genus Acetobacter which oxidized alcohol to acetic acid (produce vinegar). This can be eliminated by keeping air away from wine.

The most serious and the most common disease of table wine is tourne. This (tourne) is caused by a facultative anaerobic or aerobe which utilizes sugars and seechs to prefer conditions of low alcohol content. This type of spoilage is characterized by an increased volatile acidity a silk example type of cloudiness and later in the course of spoilage, a "mously and taste. Another type of spoilage of importance is the mala-lectic fermentation which is a spoilage condition in wines, maleic and fertaric acid are two of the predominant organic acids in grape "must" and wine. In the malo-lactic fermentation contaminating bacteria degrade malic acid to lactic acid, CO_2 thus reducing the acid content and affect flavor. This is carried out by lactic acid bacteria. Including leuconstoes, pedococia, Sas lactobacilli.

2.9 FACTORS AFFECTING THE GROWTH OF MICROORGANISM IN WINES

2.9.1 ACIDITY/ pH

The lower the pH, the less growth of micro-organisms. They are however; pH varies with the type of wine and alcohol content.

2.9.2 SUGAR CONTENT

This higher the sugar the more likelihood of spoilage

2.9.3 CONCENTRATION OF ALCOHOL this varies with the spoilage organisms, for example acetic acid bacteria are normally inhibited by about 14- 15%alcohol, while lactobacilli trictiodes grows in wine with over 20% alcohol.

2.9.4 CONCENTRATION OF GROWTH SUBSTANCE

Sources of growth substance are mainly yeast which produces growth substance ribofleven by autdysis of yeast cells. The more these substance are present, the greater the spoilage by lactic acid bacteria.

2.9.5 CONCENTRATION OF TANNING

Tanning is used for clarification and they naturally retard the growth of bacteria, but not quite appreciably.

2.9.6 AMOUNT OF SO_2 PRESENT

The more SO_2 added, the greater the retardation of spoilage organisms. However, 100-150ppm is considered appropriate.

2.9.7 TEMPERATURE OF STORAGE

Spoilage is most rapid at 20-35°C but slows down as the temperature is dropped toward freezing Refrigeration of wine is done at a temperature range of 3.9°C to 5.5°C.

2.9.8 AVAILABILITY OF AIR

Absence of air prevents growth of aerobic micro-organism such as acetobacter but increase the rate of growth of aerobic lactic acids bacteria such as lactobacillis species.

CHAPTER THREE

3.0 EXPERIMENTAL WORK

3.1 APPARATUS AND EQUIPMENT

The following apparatus and materials were used during the course of the experimental.

1. Conical flask
2. Measuring cylinder
3. Beakers
4. Pipettes
5. Transparent bottles
6. Refractometer
7. Thermometer
8. Electric PH meter
9. Weighing balance
10. Blender
11. Sieve
12. Knife

3.2 RAW MATERIALS

Well ripped tropical fruits which include, pineapple, orange and apple which are available in Minna central market.

3.3 CHEMICALS AND REAGENTS

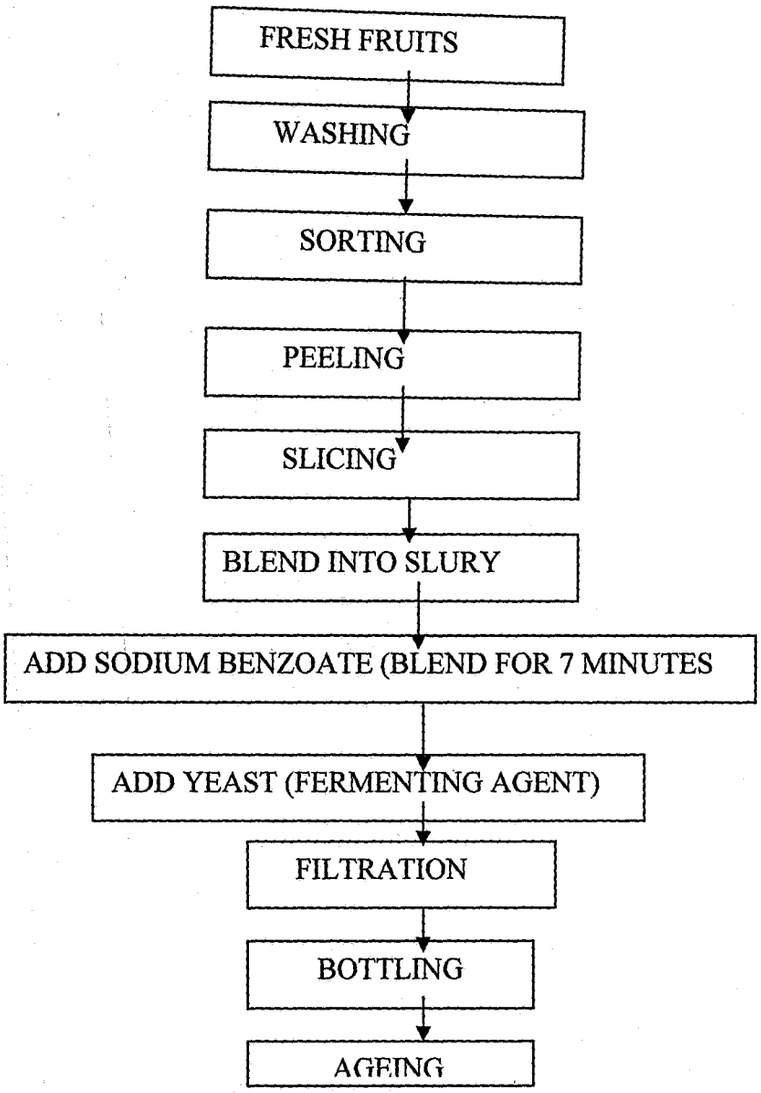
i. Sodium benzoate ($C_7H_5O_2N_a$)

ii. Sodium Hydroxide (Na OH)

iii. Distilled water

iv. Phenolphthalein indicator

3.4 PRODUCTION FLOW CHART



3.5 MANUFACTURING PROCEDURE

Fresh tropical fruits, which are apple, pineapple and orange, were used in the production during the course of the experiment which started with the sorting and washing of the fruits which were then weighed. The washed fruits were then peeled and sliced to make the blending easier. The sliced fruits were then blended after which 1g of

sodium benzoate was added to the blended fruits and blended again for seven minutes (sodium benzoate serves as a preservative). This was followed by the addition of yeast of 5g as the fermenting agent. The mixture was left to ferment at 25°C for a period of seven

days. At the end of the seventh day, the fermented liquor was filtered and bottled. The product (wine) was then analyzed for quality test.

3.6 ANALYSIS PARAMETERS

3.6.1 pH

(i) Principle:- The pH value of food is defined as the common logarithm of the number of liters of solution that contains one grain of hydrogen ion, the pH of a food can be measured either by the use of colour indicators or electro-metrically in acid base titration indicators are used which change colours as selected pH values.

The clour of phenolphthalein changes from purple to colourless at around pH of 9.0. The pH values of food stuffs which are not too highly coloured can be readily determined by the use of pH indication papers. However pH scale ranges from 0-14.

(ii) Procedure:- The pH meter (Digital pH meter) was standardized using pH buffer solution of pH value 4 and 9. The sample was poured into a 50ml beaker and the pH was determined by immersing the pH electrode into the beaker containing the wine sample.

3.6.2 ACIDITY

(i) Principle: - Depending on the indicator used or selected, the acidity of the sample can be measured by titration with alkaline to an end point and.

The titer value does not indicate whether the acid present is strong or weak.

During food storage and in food spoilage changes may occur which are due to enzymatic action and biological growth. Extent of these changes is strongly influenced by hidden concentration rather than intractable acidity.

(ii) Procedure: - 10mls of the sample was taken and 3drops of phenolphthalein indicator added into a beaker, sodium hydroxide (NaOH 0.1ml) placed independent in the burette, the preliminary titration was first carried out, followed by the full titration.

3.6.3 SOLUBLE SOLIDS

The refractometer is used to determine the soluble solid. The refractometer is an instrument calibrated in refractive index form as well as in percentage brix of the soluble

solids can be read directly from the instrument. The value of alcohol concentration can be gotten from the brix value

Alcohol content = "X" (degree brix) multiplied by "0.55"

Alcohol content = "X" x 0.55.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 TABLES OF VALUES

Parameter	Value
PH	3.5-6.8
Brix	<15
Refractive index	1.33-1.355
Alcohol content (%)	7.5-14.00

4.1.1standard properties of wine

Parameter	Value
PH	6.6
Brix	13.64
Refractive index	1.334
Alcohol content (%)	7.502

4.1.2 Properties of wine produced of same quantity (200g apples, 200g pineapples and 200g orange)

Parameter	Value
PH	6.4
Brix	13.9
Refractive index	1.350
Alcohol content (%)	7.645

4.1.3 Properties of wine produced of different quantity (Pineapple 300g, orange 200g, apple 100g)

4.2 DISCUSSION OF RESULTS

4.2.1 DISCUSSION

Wine was produced from tropical fruits (Apple, orange and pineapple) the wine extracted was tested and the following results were obtained. For the wine with the same quantity of fruits has a pH value of 6.6 and the wine produced from fruits with varying quantity of fruits had a pH of 6.4 (which implies they are both acidic but the acidity is low). The brix values for the wines are 13.64 and 13.9 for the wine with equal quantity and that with different quantity respectively.

The refractive index as gotten from the refractometer was 1.334 for the wine with equal quantity of fruits and 1.350 for the wine different quantity of fruits.

The alcohol content is the product of the brix value multiplied by 0.55, which yielded 7.502 for wine with equal amount of fruits, and 7.645 for wine produced from different amount of fruits.

All these values calculated and tabulated are in the range of standard value for the brix value, pH, refractive index and alcoholic content. For Ph, the standard value lie between 3.5-6.8, for brix value the standard lie below 15, for refractive index the value lie between 1.33-1.355 and for alcohol content the value lie between 7.5-14.00.

The 1g sodium benzoate was added so as to sterilize the mixture and to inactivate the growth of unwanted yeast and microorganisms.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION

Based on the experiments performed and the results obtained the following conclusions can be reached. The longer the wine is being preserved the better the quality of the wine as it gives a better colour and taste (ageing). The alcohol content is not too high because the quantity of sugar used was not too high as sugar increases the alcohol content.

We can say now that the production carried out was a successful one as the values of pH, brix, refractive index and alcohol content were in the range of standard value and it is safe to say good wine of acceptable quality can be produced from locally available tropical fruits. The production is an economical one which can be carried out even in air homes.

Varying the amount of fruit for the two separate wines produced didn't show much difference. But the value of alcoholic content for the wine produced with varying amount of fruit was a little bit higher as well as the acidity.

5.2 RECOMMENDATION

I recommend that the school via the department should make items and equipments available for the chemical engineering laboratory so that research can be carried out without going to other departments or institutions for assistance. The department should also make the laboratory available over the weekend so that

experiments can be carried out during the weekend for students who monitor their experiments at specific intervals that might fall during the weekend.

It will be interesting to note that the wine can be produced and available throughout the year. Therefore, I strongly recommend that tropical fruits should be used for future production of wine for commercial purposes.

Lastly, I will like to advice those going into research projects which involves a product which is to be consumed by man either as food or drink that the research project should include test for taste, colour or odour to see if the taste, colour and smell match other products already in the market. The test should be through questionnaire.

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APPENDIX

CALCULATION

Calculation of Alcohol content

Alcohol content = Degree Brix x 0.55

Let Degree brix = A

Alcoholic content = A x 0.55

- For wine produced with equal quantity of fruits

(Degree Brix) A = 13.64

: Alcoholic content = A x 0.55

= 13.64 x 0.55

= 7.502

- For wine produced with unequal quantity of fruits

(Degree Brix) A = 13.9

: Alcoholic content = A x 0.55

= 13.9 x 0.55

= 7.645.