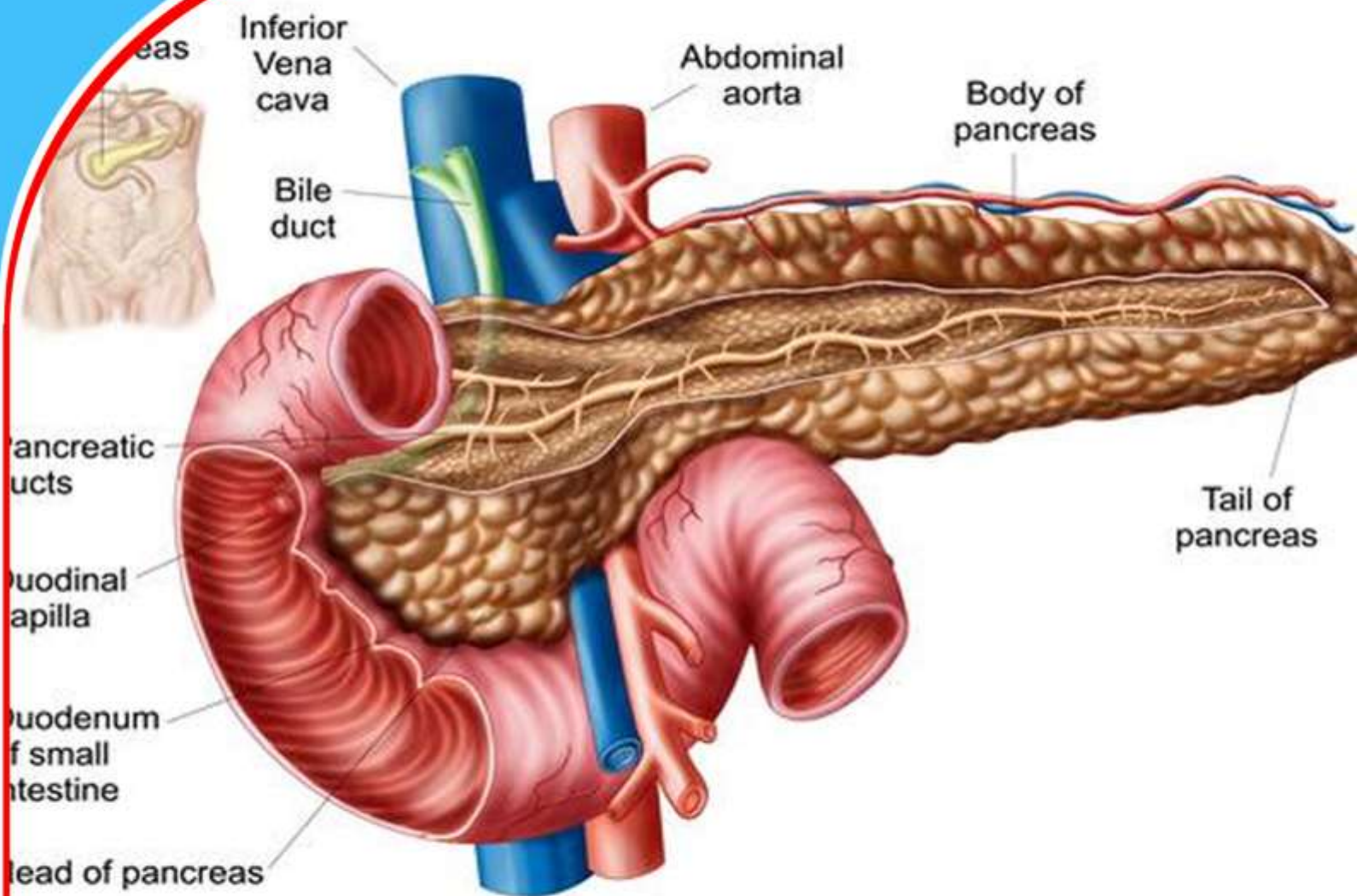


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IN THE PRODUCTION OF WINE USING ORANGES, APPLES

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ABSTRACT

Introduction: Wine is an alcoholic drink made from fermented grapes. The process of wine making involves fermentation of fruits in which case the wine is qualified by the fruit which it is made from such as apple wine, orange wine.

Purpose of the Study: This research shows the possibility of producing wine from fruits using bakers' yeast (*Saccharomyces cerevisiae*).

Methodology: The fruits used were Apple (*Malus domestica*), Orange (*Citrus sinensis*), and Pineapple (*Ananas cosmosus*). They were washed and blended. The strained juices were poured into plastic bottles to cool for 15mins before additives and yeast were added. The "must" was then allowed to ferment for four days. After four days, racking was done to remove sediments. Then egg white was added as a clarifying agent, and left to stand fifty days, for it to age and then bottled.

Findings: Apple wine was found to be more alcoholic (11.4%) while orange wine had 8.9%. Apple had the highest pH (4.0) while orange had 2.0. The solubility test showed that apple had the highest solubility with 98% while orange had 94%. Apple had the least sugar content with 9.90ml while pineapple had 22.0ml. Orange had a specific gravity of 0.99g while apple had 0.98g.

Recommendation: It is observed that all the fruits in the market today can give the qualities needed for alcoholic wine in the absence of grape fruit. All these satisfactory qualities of this study show that an acceptable wine from pineapple, apple and orange can be locally produced.

Keywords: Baker's yeast, Wine production, Fermentation

1. INTRODUCTION

Wine is a product made from the alcoholic fermentation of grape juice by using yeast (*Saccharomyces cerevisiae*) and subsequent ageing process (Adeyemi, 1985). Yeast consumes the sugar in the grapes and converts it to ethanol, carbon dioxide and heat. Rosim 1998 reported that the most widely use fruit for wine making is “Grape” (*Vitis vinifera*). Grape has a lot of advantage over other fruits such as sufficient moisture content but not withstanding other fruits can still be used in the production of wine. Yeast are fungi and occur in substrate with high or moderate sugar content. The yeast contributed to the organoleptic qualities of wine (Jone, 1981).

Citrus fruits and other fruits harbor natural flora of microorganism called “Wild” and are capable of “Must” fermentation on their own. Wine contain a complex mixture of organic and inorganic compound, organic compounds found in wine include ester, acids such as titeric acid, citric acid, succinic acid, tannin and pectins. The presence of these acids confers organoleptic qualities of wines and help maintain low Ph which favors yeast growth and inhibits the growth of many undesirable bacteria (Joselyn & Amerine, 1980). During fermentation glucose and fructose present in “must” are converted to alcohol. By this, fermentation is a metabolic process bringing about chemical change in organic substrate through the action of enzyme of microorganisms or other cells (Amerine *et al.*, 1980). Prescott and Dunn, 1982 reported that rapid multiplication of yeast cells at starting of the fermentation and later stage requires an anaerobic condition. After fermentation the wine is cloudy from suspended yeast and contains an excess amount of CO₂. During storage, most of the suspended yeast precipitates out naturally and supernatant clear wine is then removed from the sediments by racking (Amerine, 1988) followed by ageing. After ageing, the wine is ready for bottling and may be blended giving a final polish filtration (Bussy, 1975). Any particles left in the wine after racking are taking out by passing it through filter before bottling (Harold, 1989).

During pressing of juice from the fruits and at the same time yeast, microorganisms from the skin pass into the juice. The kind of bacteria which have been isolated from wine and “must” are Bacillus, lactic acid bacteria and acetic acid bacteria (Forashun, 1976). Lactic acid bacteria and acetic acid bacteria played prominent roles in wine making. The lactic acid bacteria are represented by three genera; *Lactobactocilus*, *Lancosto* and *pediococcus* species while acetic acid bacteria are represented by *Gluconobacter* and *Acetobacter*. Wheather their growth is viewed a negative or positive depends on wine making philosophy, wine chemistry and the organisms involved (Bringer and Salam, 1984). Buplesis, 1974 recorded the isolation of some *Bacilli* and *Pediocci* from spoiled wines. The high level of alcohol and sulphurdioxide in “must”, its high acidity and low contents of nitrogenous materials makes wine a hostile environment for almost all kinds of bacteria. The susceptibility of to microbial spoilage depends in various factors such as pH, sugar content, concentration of growth factors, concentration of alcohol, temperature and availability of oxygen. Three different fruits where used in this research namely; Orange, Pineapple and Apple.

Orange (*Citrus sinensis*) belongs to family Rutaceae and had a very high commercial value. It’s a native to Himalaya region of India but has spread to tropical and subtropical region of the world.

It has soft, leathery peel cover and fleshy edible interior. The peel consists of a colored outer layer called “Flared” and a white spongy inner layer called “Albdo”. The interior of the orange consists of 10-15 segments which surrounds the spongy core. Oranges are valued for their delicious juice and high vitamin C and several vitamin B (Longo & Villa *et al.*, 1991). Orange have a distinctive aroma or flavor, it’s eaten a fresh, frozen or canned juice. The peel and pulp are used as cattle feed and manure in farm. The oil from the peel is used in perfumes flavoring. Oranges could be used to produce wine.

Apple (*Malus domestica*) belongs to the family Rosaceae. The tree originated from southwest Asia. Apple is a deciduous tree generally standing 6-15ft tall in cultivation and up to 30ft in the wide. When cultivated the size, shape and branch density are determined by rootstockselection and trimming method. Apple can grow anywhere excluding extremely hot or extremely cold climates (Jules *et al.*, 1996). An apple tree which is properly cared for can bear fruits for a period of thirty years or even longer (Smith & Archibald, 1997).

Pineapple (*Ananas cosmosus*) is a tropical plant with an edible fruit (Morton & Julia, 1987) and the most economically significant plant in the family Bromeliaceae (Coppens *et al.*, 2003). Pineapple maybe cultivated from the offset produces at the top of the fruit (Morton & Julia, 1987) and possibly flowers between 5-10months and fruiting I the following 6months. It is a native of southern Brazil and Paraguay where the wild relatives occur. Pineapple is herbaceous perennial which grows 3.3-4.9 ft tall, although sometimes it can be taller. In appearance, the plant is short, stocky stem with tough waxy leaves. They are drought tolerant and will produce fruit under yearly precipitation rates ranging from 25-150inch depending on cultivar, location and degree of atmosphere humidity. The best soil for pineapple is well drained sandy loam with high organic content and the pH should range from 4.5-6.5. The fruit cannot stand water logging. Pineapple carries out CAM photosynthesis (Gibbson & Arthur, 2016) fixing carbon dioxide at night and storing it as the acid malate, then releasing it during the day aiding photosynthesis.

2. MATERIALS AND METHOD

2.1 COLLECTION OF MATERIALS

The oranges, pineapples and Apples, yeast, sugar, knife, filter cloth, blender, Rubber containers, Rubber bands, granulated sugar, Egg white was bought from Eke Awka market conical flask, pipette, Burette, measuring cylinder sensitive weighing balance, funnel, NaoH, Hcl, Brix-hydrometer, Petri-dish, centrifuge, filter paper, and incubator were provided by laboratory technologist of Botany department while Benedicts solution, Na₂CO₃, was bought from a chemical shop at Aroma junction, Awka, Anambra state.

2.2 EXPERIMENTAL DESIGN

1. **Washing of Fruits:** The samples were thoroughly washed with distilled water to remove dirt's and dusts particles picked up from the farm or when transported to the market. The backs and seeds were equally removed to avoid sour taste during this process.
2. **Blending:** The samples were blended with the help of LG electric blender of model SB-242. The samples were crushed very well and in a very neat environment too to avoid any contamination by microorganisms.
3. **Stain of Juice:** The juice were squeezed out from the crushed fruit with the help of filter cloth and then placed in a plastic pail.
4. **Must:** The strained juice allowed cooling for 15 minutes before the addition of certain additive to the must so as to increase the nutrient available for the yeast. Six hundred gram of granulated sugar were dissolved in 500ml of distilled water, and then transferred into the pail so that fermentation can start respectively.
5. **Primary Fermentation:** The must was covered with nylon and secured by means of rubber band, the primary fermentation of the oranges, apples and pineapples lasted for 4 days respectively at room temperature of 35°C at the end of which the yeast sediment. The yeast concentration increases as fermentation proceeds.
6. **Secondary Fermentation:** After primary fermentation has ended, the secondary fermentation lasted for 8 days at room temperature of 35°C. After secondary fermentation, the yeast was removed by filtering the wine into a sterilized far.
7. **g. Racking:** This simply means drawing-off wine from the sediments. At this point the must have sediment very well enough, the "must" were separated with the use of filter paper, funnel and beaker during the filtering. After filtration wine is transferred to cask where it remained for 50 days during which sediments are occasionally removed.
8. **New wine:** The filtrate from the racking is now called wine, at this point it has a sour taste and a yeast odor but it is more pure and neither than before because it is free from must sediments. These wine were added to distillation column for further purification. The wine is free from impurities and microbial affects.
9. **Clarification/Fining:** This lasted for 50 days and egg white was added as a clarifying agent. This can equally be described as the process of transforming a fresh cloudy juice into a clear one knows as fining or clarification. Bentonite was also added to remove unstable proteins and other collides from the wine. This will result in the attraction of positively charged proteins and so form larger particles that are too heavy as well as being electrically neutral to remain in solution.

10. **Maturation/Aging:** This refers to allowing of wine to remain unperturbed at a fairly constant temperature from the moment it was clarified to the time it is drunk. Newly fermented wine is cloudy, harsh in taste, yeasty in odor and without pleasant bouquet that develops later in its history. Wine matures as a result of slow chemical changes which contribute to flavor and bouquet.
11. **Bottling:** This is done after all the necessary winery for wine has been added. After bottling, maturation can still go on if fermentation were not halted the optimum time in the bottle depends on the wine, for a vintage changing, the period may be as long as 20 years.

2.3 TITRATABLE ACIDITY

The method used was described by Amerine and Ough (1980). The titrable acidity was expressed in terms of tartaric acid and was calculated using the formula tartaric acid g/100ml

$$= \frac{v \times m \times 75}{10000 \times V}$$

v = volume of NaOH used to titrate to the end point

m = molarity of NaOH (0.1 is recommended)

V = the volume of the juice sample (10ml is recommended)

Since 0.1m of NaOH and 10ml sample of the juice were used respectively, the formula above is simply

$$T. Ag/ 100ml = \frac{v \times 0.1 \times 75 \times 100}{1000 \times 10}$$

$$= 0.075. \text{ Therefore the end point is } 0.075$$

2.4 SPECIFIC GRAVITY (FOR PERCENTAGE ALCOHOL YIELD)

The method employed was the distillation method. The principle is based on the vapor density of the solvents from the solution (wine). A conical flask covered with a rubber stopper containing antidumping clips, this helps to prevent the flask from exploding during heating. The conical flask was connected to the libeing condenser meanwhile a tube was connected from the end of the condenser to the mouth of the receiving flask. A constant distillate from running back into the flask containing the must. 100ml of the wine sample were measured in a volumetric flask and then transferred to a distillation flask, rinsed with distilled water. The sample was distilled over a small gentle flame and the distillate collected into a volumetric flask (90ml). The volume was made up to 100ml with distilled water to help in the reading of the specific gravity under the temperature of 35°C according to AOAC methods, 1980.

Calculations for orange, pineapple and Apple

Weight of bottle + sample (Apple) = 61.85g

Weight of bottle + sample (pineapple) = 61.9g

Weight of bottle + sample (orange) = 62.73g

Weight of bottle + Distilled water = 62.60g

Weight of empty bottle = 14.3g

Weight of Apple distillate = 47.55g

Weight of pineapple distillate = 47.60g
 Weight of orange distillate = 47.7g
 Weight of distilled water = 48.30g
 Specific gravity of Apple wine
 Weight of Apple distillate
 Weight of equal volume of distillate

$$= \frac{47.55\text{g}}{48.30\text{g}} = 0.98447 = 11.37\%$$

Specific gravity of pineapple wine
 Weight of pineapple distillate
 Weight of equal volume of distillate

$$= \frac{47.60\text{g}}{48.30\text{g}} = 0.98550 = 10.50\%$$

Specific gravity for orange wine
 Weight of orange distillate
 Weight of equal volume of distillate

$$= \frac{47.7\text{g}}{48.30\text{g}} = 0.98758 = 8.89\%$$

3. RESULTS

3.1 CALCULATION FOR TITRABLE ACIDITY

Table 1: Orange Must

Burette Reading (ml)	1 st Day	2 nd Day	3 rd Day	4 th Day
Final	5.50	5.80	7.60	8.60
Initial	0.25	0.25	0.25	0.25
End point	5.25	5.55	7.35	8.35

This was done using titration method, and the readings for each day were taken with the use of Burette. The initial reading for the 1st, 2nd, 3rd and 4th day were given as 0.25, which is constant for the 4th days with the final readings as 5.50, 5.80, 7.60 and 8.60 respectively for Apple must.

$$V \times M \times 75$$

$$1000 \times V$$

V = Volume of NaOH used to titrate to the end point

M = molarity of NaOH (0.1 is recommended)

V = the volume of the juice sample

$$T.A = 100\text{ml} = \frac{V \times 0.1 \times 75 \times 100}{1000 \times 10} = 0.075$$

= 0.075 therefore is the end point

T. Acidity for 1st day = $5.25 \times 0.075 = 0.39\text{ml}$
 T. Acidity for 2nd Day = $5.55 \times 0.075 = 0.42\text{ml}$
 T. Acidity for 3rd Day = $7.35 \times 0.075 = 0.55\text{ml}$
 T. Acidity for 4th Day = $8.35 \times 0.075 = 0.62\text{ml}$

Table 2: Pineapple Must

Burette Reading (ml)	1 st Day	2 nd Day	3 rd Day	4 th Day
Final	7.70ml	8.50	8.84	9.84
Initial	0.25	0.25	0.25	0.25
End point	7.45	8.25	8.59	9.59

The initial readings for pineapple must were 0.25 for the four days respectively. While the final readings were taken as 7.70ml, 8.50ml, 8.84ml, 9.84ml respectively for the four day. The endpoint was gotten from the final reading minus the initial reading which is 7.45, 8.25, 8.59 and 9.59 respectively for the 4 days.

T. Acidity for 1st day = $7.45 \times 0.075 = 0.56\text{ml}$
 T. Acidity for 2nd Day = $8.25 \times 0.075 = 0.62\text{ml}$
 T. Acidity for 3rd Day = $8.59 \times 0.075 = 0.64\text{ml}$
 T. Acidity for 4th Day = $9.59 \times 0.075 = 0.72\text{ml}$

Table 3: Apple Must

Burette Reading (ml)	1 st Day	2 nd Day	3 rd Day	4 th Day
Final	13.60	13.90	14.25	14.55
Initial	0.25	0.25	0.25	0.25
End point	13.35	13.65	14.00	14.30

Also the readings for Apple must were equally recorded and the initial reading which is constant is 0.25, final readings were taken as 13.60, 13.90, 14.25, 14.55 respectively while the end point (final-initial) were 13.35, 13.65, 14.00 and 14.30.

T. Acidity for 1st day = $13.35 \times 0.075 = 1.00\text{ml}$
 T. Acidity for 2nd Day = $13.65 \times 0.075 = 1.02\text{ml}$
 T. Acidity for 3rd Day = $14.30 \times 0.075 = 1.07\text{ml}$
 T. Acidity for 4th Day = $9.59 \times 0.075 = 0.72\text{ml}$

3.2 ESTIMATION OF REDUCING SUGAR

The quantitative estimation of reducing sugar of the sample was determined using the method described by Plummer (1971). The samples were placed in 50ml burette, 25ml of Benedict's quantitative reagent were pipette into 250ml conical flask and 35g of anhydrous sodium carbonate (Na_2CO_3) were added to the flask and boiled. During the boiling, sample from the Burette were added slowly until the last trace of blue color of the Benedicts solution disappeared and then brown precipitate were formed respectively. The formation of Brown precipitate marked the end of titration and the values for each sample were noted.

The initial readings were constant for that of orange, apple and pineapple. The records were taken for 4 days for each of the fruits, the final readings for orange are 2.60, 5.60, 7.90 and 10.30 with their end points as 2.60, 5.60, 7.90 and 10.20 for the 4 days. That of pineapple were equally taken and the figures obtained were 5.10, 18.10, 21.25, 22.00 and so also for apple as 5.80, 7.90, 9.20 and 9.20 respectively for the four days. The weight in gram of reducing sugar per 100ml of solution was calculated using the formula

$$\frac{K \times 100 \times N}{v} \quad (\text{Plummer, 1971})$$

Where K = Reducing sugar content

For glucose K = 0.050

For fructose K = 0.053

N = Number of times the sample was diluted

V = volume of sugar solution required for titration

Table 4: Orange Must

(ml) Burette Reading	1 st Day	2 nd Day	3 rd Day	4 th Day
Final	2.60	5.60	7.90	10.30
Initial	0.25	0.25	0.25	0.25
End point	2.60	5.60	7.90	10.30

$$\text{For 1}^{\text{st}} \text{ Day Glucose} = \frac{0.050 \times 100 \times 1}{2.60} = 1.92$$

$$\text{Fructose} = \frac{0.053 \times 100 \times 1}{2.60} = 2.04$$

$$\text{For 2}^{\text{nd}} \text{ Day Glucose} = \frac{0.050 \times 100 \times 1}{5.60} = 0.89$$

$$\text{Fructose} = \frac{0.053 \times 100 \times 1}{5.60} = 0.95$$

$$\text{For 3}^{\text{rd}} \text{ Day Glucose} = \frac{0.050 \times 100 \times 1}{7.90} = 0.63$$

$$\text{Fructose} = \frac{0.053 \times 100 \times 1}{7.90} = 0.67$$

$$\text{For 4}^{\text{th}} \text{ Day Glucose} = \frac{0.050 \times 100 \times 1}{10.30} = 0.49$$

$$\text{Fructose} = \frac{0.053 \times 100 \times 1}{10.30} = 0.51$$

Table 5: Pineapple must

Burette Reading (ml)	1 st Day	2 nd Day	3 rd Day	4 th Day
Final	5.10	18.10	21.25	22.00
Initial	0.25	0.25	0.25	0.25
End point	5.10	18.10	21.25	22.00

$$\text{For 1}^{\text{st}} \text{ Day Glucose} = \frac{0.050 \times 100 \times 1}{5.10} = 0.98 \quad 0.98$$

$$\text{Fructose} = \frac{0.053 \times 100 \times 1}{5.10} = 1.04$$

$$\text{For 2}^{\text{nd}} \text{ Day Glucose} = \frac{0.050 \times 100 \times 1}{18.10} = 0.28$$

$$\text{Fructose} = \frac{0.053 \times 100 \times 1}{18.10} = 0.29$$

$$\text{For 3}^{\text{rd}} \text{ Day Glucose} = \frac{0.050 \times 100 \times 1}{21.25} = 0.24$$

$$\text{Fructose} = \frac{0.053 \times 100 \times 1}{21.25} = 1.25$$

$$\text{For 4}^{\text{th}} \text{ Day Glucose} = \frac{0.050 \times 100 \times 1}{22.00} = 0.23$$

$$\text{Fructose} = \frac{0.053 \times 100 \times 1}{22.00} = 0.24$$

Table 6: Apple must

Burette Reading (ml)	1 st Day	2 nd Day	3 rd Day	4 th Day
Final Reading	5.80	7.90	9.20	9.90
Initial Reading	0.25	0.25	0.25	0.25
End point	5.80	7.90	9.20	9.90

1st Day: Glucose = $\frac{0.050 \times 100 \times 1}{5.80} = 0.86$

Fructose = $\frac{0.053 \times 100 \times 1}{5.80} = 0.91$

2nd Day: Glucose = $\frac{0.050 \times 100 \times 1}{7.90} = 0.63$

Fructose = $\frac{0.053 \times 100 \times 1}{7.90} = 0.67$

3rd Day: Glucose = $\frac{0.050 \times 100 \times 1}{9.20} = 0.54$

Fructose = $\frac{0.053 \times 100 \times 1}{9.20} = 0.58$

4th Day: Glucose = $\frac{0.050 \times 100 \times 1}{9.90} = 0.51$

Fructose = $\frac{0.053 \times 100 \times 1}{9.90} = 0.53$

3.3 pH DETECTION/ACIDIC TEST

The pH of the wine was detected using what man pH strip. The pH strip was dipped into the wine and the color change compare with a standard pH color chart.

Table 7: pH detection/acidic test

Day	Orange	Pineapple	Apple
1	6.0	5.0	7.0
2	5.5	4.5	6.0
3	3.5	3.5	4.5
4	2.0	3.0	4.0

From the chart above, I gathered that orange must were acidic (6.0), pineapple must were very acidic (5.0) while Apple must were neutral (7.0). On the first day but reduces as days passed by.

3.4 FERMENTATION RATE

This is obtained by calculating the Brix reading in day one minus brix reading in the last day divided by the number of Days of primary fermentation

$$\begin{aligned} \text{For orange} \quad \text{FR} &= \frac{1.040 - 1.000}{4} = 0.01 \\ \text{For pineapple:} \quad \text{FR} &= \frac{1.060 - 1.000}{4} = 0.015 \\ \text{For apple:} \quad \text{FR} &= \frac{1.070 - 1.000}{4} = 0.0175 \end{aligned}$$

Table 8: Solubility test

Samples	Percentage
Pineapple	95% soluble
Orange	94% soluble
Apple	98% soluble

This was done by using the centrifuge, with the use of spatula remove the residue, add little quantity of ethanol and stir, then view under microscope and take the records.

Table 9: Physical and chemical properties of wine produced (Orange, Pineapple and Apple)

Properties	Orange	Pineapple	Apple
Titration acidity(ml)	0.62ml	0.72ml	1.07ml
pH (acid test)	2.0	3.0	4.0
Specific gravity(g)	0.98758g	0.98550g	0.98447g
Alcohol content	8.89%	10.50%	11.34%
Reducing sugar (ml)	10.30ml	22.00ml	9.90ml
Solubility (%)	94%	95%	98%
Fermentation	0.01	0.015	0.0175

Table 10: Comparative study of oranges, pineapples and apple must

Properties	Orange	Pineapple	Apple
Fermentation	Vigorously	Vigorously	Vigorously
Color before fermentation	Pale yellow	Dark yellow	Pale green
Foam ahead	Foam lead very small	Small but bigger than pineapple	Very small
Color after fermentation	Amber in color	Pale yellow	Pale lemon
Alcohol content	10.50%	9.89%	11.37%
Solubility	94%	95%	98%
Fermentation	0.01	0.015	0.0175

4. DISCUSSION

Fermentation is a form of anaerobic respiration in which there is incomplete breakdown of food with the formation of carbon iv oxide (CO₂) and other product such as alcohol (Jones, 1981). According to Amerine (1979), the quality of a wine is a reflection on the quality of fruits bought. So a very good and ripe oranges, apples and pineapples were bought. He also reported that wines with higher alcoholic contents last longer due to its power to inhibit influence of microorganisms, from the wine produced. It were discovered that apple wine has more alcoholic percentage while orange wine has lower percentage of alcohol, apple wine has the alcoholic percentage of 11.37%, followed by pineapple wine with 10.50% alcohol and the least is orange wine with alcoholic percent of 8.89%, therefore the possibility of lasting wine is less in orange wine, but higher in Apple wine.

According to Jacobs (2001) wine obtained from pulp fermentation has more (outer part of citrus fruits used in flavoring) astringency (taste or smell) than that from Juice only, it has richer color but whether-pulp or juice, fermentation is adopted. The fermentation rate of apple wine were higher (0.0175), followed by pineapple wine (0.015) and the lowest were orange wine (0.01). The physical and chemical properties (table 9) showed that the titrable acidity is still higher in apple must with 1.07ml and orange must being the least with 0.62ml. This was done with the process called titration method. The pH tests were conducted and the results were obtained with the aid of pH chart and were discovered that apple has more pH value (acidic test) with 4.0. Orange has the lowest pH value of 2.0 followed by pineapple wine that has 3.0 pH values. The solubility tests were done with equipment known as centrifuge, results obtained indicated that apple wine equally have more solubility than orange wine and pineapple wine. Apple wine has the solubility of 98%, followed by pineapple wine that has pH solubility test of 95% and the least being orange 94% soluble. From these results gathered here, it shows that apple wine has more what it takes to make a good and quality wine than orange. This agrees with the report by Forashun (1976) he reported that what makes a wine “good” are the characteristics obtained from it.

Kunle and Goswell (1972) opined that higher sugar content lead to attraction of microorganism. From the test of reducing sugar, apple wine has lesser sugar content 9.90ml followed by orange wine with 10.30ml while pineapple wine has the highest level of sugar content of 22.00ml. The primary and secondary fermentation lasted for 4 days and 8 days respectively for orange, apple and. The yeast sediment at the bottom of the fermentation jars. The effect of dissolved oxygen, temperature, cell count and sugar concentration on viability of yeast in rapid fermentation has been studied by Nagodawithans (1974). They found those ethanol fermentation rates were affected by alcohol content. Decrease in specific gravity and a total dissolved solid of the fermenting must were due to the metabolism of sugar by the yeast to produce alcohol. This agrees with the result of this research work which showed the specific gravity of orange wine has the highest specific gravity of 0.987 followed by pineapple wine 0.985 and the least been apple wine 0.984.

From the comparative table 10, their fermentation commenced that is after blending, pineapple must has a pale yellow color, orange- dark yellow and apple pale green color but after fermentation has taken place, their colors changes due some enzymes and catalyst has acted on them. The color for pineapple after fermentation is Amber-in color while orange is pale yellow in color and apple has pale lemon color. It is good to know that all the fruits we see in the market can give us the qualities we need for our alcoholic wine in the original grape fruit for wine is not found. All these satisfactory positive result of this study shows that in acceptable wine with good viability from pineapple, apple and orange fruit using good strains of wine yeast (*Saccharomyces cerevisiae*)

5. CONCLUSION

The fermentation of orange, pineapple and apple (must) with cultured yeast (*Saccharomyces cerevisiae*) led to the successful production of wine. The yeast used for both fermentation was noticed few minutes after inoculation of the yeast into the must following this fermentation test, this showed the possibility of using a locally available substrate other than the traditional grape which is not in Nigeria for wine making. There is need for the development of local industries to take care of the increased rate of wine consumption in the country and to reduce the wastage recorded after every harvesting season as a result of our inability to utilize majority of our indigenous fruits such as orange, apple, mango, pineapple etc. This study is a prove of the possibility of developing efficient method of wine production using oranges, apples, and pineapples as the sole source of raw materials.

Also, industrial production of wine from orange, pineapple and apple etc would help to curb unemployment problems among air teeming population and reduced drastically from this work, wine making could be produced commercially in Nigeria using locally-available fruits/substrate.

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