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Rare fruits as a source of nutrient rich fermented products

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An experiment was conducted at MGM College of Agricultural Biotechnology, Aurangabad .The fruits such as banana custard apple, papaya, date are processed for fermentation. Fruits are fermented anerobically by utilizing sugars in fruits with the help of yeast Saccharomyces cerevisiae. The fermented products are distilled at $60^0$and percentage of the alcohol is determined by calculating specific gravity of the distillate. The values alcohol percentage of the distillate prepared from banana, papaya, custard apple, dates are 8.2, 8.1, 8.2, 8.1, 8.1, and 8.2, respectively which are within the range of the values of alcohol percentage of the fruit wines (8% to 13 %) This indicates that using the same species of yeast *i.e.* Saccharomyces cerevisiae and same processing conditions various dry white wines of different aroma can be prepared from fruits other than grapes.

In this experiment normal alcoholic fermentation of sound fermentable agricultural products, either fresh or dried or of stored or unstored with the addition of water before or during the fermentation is carried out to correct natural moisture deficiencies (Industrial microbiology by Agrawal and parihar) Although grapes are by far the most often used fruit , various other fruits such as banana,papaya,custard apple, dates can also be used to make wines.Fermentation is the process by which a microorganism(yeast) converts sugar into alcohol and carbon dioxide gas. The dried yeast cells must reabsorb all their water the cells literally act like dried sponges and suck up the needed water in seconds.(water uptake.)Not only will yeast cells not disperse very well if not rehydrated ,they can loose a large amount of cytoplasm ,reducing the efficiency of oxygen and nutrient transfer to the cells This impedes growth and activity causing sluggish or stuck fermentation .Proper rehydration can ensure healthy yeast cells and good fermentation characteristics (.http:/www.lallemand.com/danstar-lalvin/lalvinrehyd.html; http:/www.lallemand.com/danstar-lalvin/inferment/claytonHints.html.; http:/winemaking.jackeller.net/yeast.asp; http:/home.att.net/lumeisenman/chapt12.html)

Wine and beer canbe made from any plant material that contains free sugar but, we generally equate a nutrient as anything that wine yeasts needs on order to survive ,ranging from food ,vitamins, and chemicals to the air and everything in between wine with grapes and these fruits and beer/whisky with grains. When actively dry wine yeast is made in the laboratory, one should remove excess water both inside the cell and outside effectively putting the yeast in a desiccated hibernation state until we are ready to use it. Yeast is a unicellular fungus which reproduces asexually by budding or division especially the genus Saccharomyces which is important in food fermentations. (Walker, 1988) Saccharomyces cerevisiae genus are the most common yeasts in fermented foods and beverages based on fruits and vegetables. All strains of this species ferment glucose and many ferment other plant derived carbohydrates such as sucrose, maltose and raffinose. There are several variables which can affect the fermentation process and final quality of wine. Temperature has an impact on the growth and activity of different strains of yeast. A temperature of 10^0 to 15^0 the non Saccharomyces species have an increased tolerance to alcohol and therefore, have the potential to contribute to the fermentation. Wines produced from grapes grown in colder climates tend to have a higher conc. Of malic acid and a lower pH (3.0 to3.5) and the test benefits from the slight decreases in acidity . The benefits of this process is that it imparts flavors and aromas to the wine. (Santon R.W.(1985) Food fermentations in the tropics in “Microbiology of fermented food” ,edited by Wood,B.J.B. Elsevier Applied science Publishers,UK) ,(Ashe ,Arthur J.III “Fermentation” World Book Encyclopedia,1999). (“fermentation” 11-14-01 http:/pasture ecn. edu. purdue.edu/~agen 5561 bread /html/fermentation html).

For making wine successfully along with the substrate, other factors should also be considered such as temperature pH Sugar concentration, of the fruits etc .Any yeast which is capable of fermenting sugar will ferment glucose faster. Saccharomyces cerevisiae belongs to glycophilic species and therefore unfermented sugar may contain relatively higher percentage of fructose. The low pH can be considered as selective and favorable factor. The effect of pH on growth of yeast and activity also depends upon the concentration of sugar and ethanol Temperature consequently affects to the yeast in the course of wine fermentation. The fermentative metabolism of yeast cell can be carried out within the range of 15^0C to 35^0C For production of white wines in Germony temperature between 18^0C to 20^0C have been recommended by Troost in1972 . If substrate contains high sugar concentration the high osmotic pressure has a negative effect on yeast cell At higher sugar level alcohol formation decreases.

For the preparation of a fermented product from fruits an efficient protocol was developed. The overall procedure was divided into five steps.

- Activation of the yeast
- Preparation of substrate and inoculation
- Fermentation
- Filtration
- Distillation
- Characterization

In the activation of yeast, the active dried yeast (Saccharomyces cerevisiae)from local market was rehydrated by adding 1 gram of dried yeast and pouring it into 100 ml of 1 % glucose solution. The solution was stirred and allowed the yeast suspension to stand for at least 15 min. The solution was kept overnight for activation.

For the preparation of substrate the fruits such as papaya, date, custard apple, and banana were used as the substrates and treated separately. A batch of custard apple was fermented by using the same culture grown on synthetic medium .The synthetic medium had the composition:

KH_2PO_4	0.055 g
KCl	0.042 g
$CaCl_2.H_2O$	0.012 g
$MgSO_4$	0.012 g
Fe Cl_2	0.00025 g
$MnSO_4.H_2O$	0.00025 g
$NH_4.H_2O$	0.02 g
Yeast extract	0.1 g
Citrate buffer	5ml

100 gm peeled fruits were weighed and it was chopped and boiled in about 100 mls of water .After cooking the solution was strained some minute pieces of fruits were allowed to left in the solution. The mixture was added with chopped raisins, and sugar .Add lemon juice and malt extract The volume was made up to 1000 ml. with distal water. The medium was inoculated with 1 ml of activated yeast culture .The mixture was incubated for seven days. The mixture contained following composition.

Malt	10 g
Lemon	juice of 2 lemons
Fruit pieces	100 g
Sugar	10 g
Raisins	10 g
Water	1000ml

In the third step, the fermentation was carried out for seven days. All the ingredients were sterilized and added aseptically to avoid contamination. The material was kept in anaerobic conditions. During incubation there were heavy effervesces of carbon dioxide gas which were tested for its properties. After seven days the color of the medium was changed it was slightly brownish. The medium was strained again to remove the residual fruit pieces. After further incubation for seven days, the medium was subjected for distillation.

Table 1 : Observations of the both after ten days incubation

Sr. No.	Name of the fruit	Observations
1.	Dates	Evolution of high amount of gas after fifth day
2.	Custard apple (with activated yeast)-S_1	Less evolution of gas .No proper mixing of the medium contents.
3.	Custard apple (culture grown on synthetic media) S_2	The sample becomes highly turbid due to evolution of gas.
4.	Papaya	After 10 days incubation the solution becomes turbid.
5.	Banana	After 10 days incubation formation of scum takes place.

For distillation of culture broth the temperature was adjusted up to 60^o C .Approximately 10 % solution was recovered after distillation for one hour. After boiling brown colored broth was transformed into white colored distillate which was collected and subjected for sensory evaluation.

The white colored distillate was subjected for iodoform tests. The white coloured crystals were seen under microscope which were similar to the crystals of absolute alcohol.(www.chemguide.co.uk/organicprops/

Table 2 : Physical and chemical characteristics of the distillate

Sr. No.	Type of the fruit	Sugar (gm in 100 gm)	Volume of the distillate (ml)	Colour	Odour	Iodoform test	Specific gravity	Alcohol %
1.	Banana-I	15.1 -22.4	360	White	Sweet	Positive	0.9887	8.20
2.	Banana -II	15.1 -22.4	205	White	Sweet	Positive	0.9592	7.95
3.	Papaya I	5.9-11.1	400	White	Sweet	Positive	0.973	8.11
4.	Papaya II	5.9-11.1	200	White	Sweet	Positive	0.958	7.95
5.	Custard apple using S_1 I	18-20	320	White	Alcoholic	Positive	0.9899	8.20
6.	Custard apple using S_1-II	18-20	50	White	Sweet	Positive	0.9844	8.20
7.	Custard apple using S_2	18-20	133	White	Sweet	Positive	0.9826	8.16
8.	Custard apple using S_2	18-20	83	White	alcoholic	Positive	0.9928	8.20
9.	Dates I	44.88	410	White	Sour	Positive	0.9837	8.16
10.	Dates II	44.88	140	White	Sour	Positive	0.9989	8.20

carbonyls/iodoform.html)After confirming the presence of alcohol in the distillate, quantitative estimation of the alcohol in the broth was carried out by using specific gravity method. The specific gravity can be determined by the formula:

$$\textbf{Specific gravity} = \frac{\textbf{Weight of the distillate}}{\textbf{Weight of water}}$$

The results were compared with that of grape fruit because most of the work of fruit fermentation was done with grapes .Distillates of initial and final stages were taken separately as the temperature is the critical factor in the process. Temperature optima as well as maximum and minimum, which can be tolerated, were distinctly different for yeast respiration, fermentation, cell growth and alcohol tolerance. The temperature slightly rises in the later session of distillation which affects alcohol percentage of distillate and it was also stated by White and Munns in the paper entitled and published in 1951. It is also discussed by Prescott and Dunn in the book industrial microbiology.

Alcohol accounts for the major portion of the yeast metabolism. Guymon and Heitz (1952) determined an average content of 250 mg/ltr for white wine (120 samples) but effect of aroma of white wine is lesser than one could expect on the basis of their quantitative dominance. Webband Ingraham (1963), Rainbow (1970) The total concentration of aroma substance was about 0.8-1.0 g /ltr (Rapp *et al.*) states that the most significant enrichment of the aroma of the wine was due to the presence of many and varied products of yeast metabolism The use of raisins was beneficial because it will supply natural yeasts needed to start fermentation .A really superior wine was made using raisins in more sophisticated recipes with good yeast.(Dirar,H(1993) : " The indigenous Fermented Foods of the Sudan: A study in African Food and Nutrition'' CAB international, UK. The Ethanol content of the table wine is 8 % to 15 % by volume. In this experiment the values were at par and ranging from 7 % to 8 % Thes values were correlated with the sugar concentrations .as shown in Table 3

As per the observations in Table 2 banana (I^st^ distillate) custard apple (I^st^ distillate) and dates (II^nd^ distillate) were having highest alcohol percentage *i.e.*8.20, where as the papaya was having comparatively less percentage of the alcohol .Banana which was having 15.1 -22.4 g sugar was producing 8.20 % alcohol and dates which have 44.88 g sugar was also having the same percentage. Papaya which was having least sugar (5.9-11.1) was also produced less percentage of alcohol.

According to Table 3 in our preparation the specific gravity of the distillate was at par to the values shown in the table. It was also described in the book Industrial microbiology by Prescott and Dunn(Topic Wiley H.W. Americamn WinesAt the Parisexpositionof1900: Their Composition and character, U.S. Dept. Agr. Bur. Chem, Bull. 72, 1903)

Table 3 : Classification of wines according to the sugar content

Type	Specific gravity	Sugar content (wt%)
Dry wine	1.085 – 1.100	21 – 25
Medium sweet wine	1.120 – 1.140	29 – 33
Sweet wine	1.140 – 1.160	33 – 37

Thus dry white wines can be produced with an average specific gravity of 0.9917.

Conclusion:

In our experiment we prepared the dry white wines from different fruits such as banana, dates papaya and custard apple. Generally wine is the product of grape. The standards which were used to confirm that the prepared product was nothing but wine. The values matched to our product. The values of alcohol percentage and specific gravity were the medium to standardize the product. Thus we can prepare nutritious wines from fruits. This helps to avoid the post harvest losses occurred in the fruits due to its low shelf life.

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