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FULL LENGTH ARTICLE

Production of fermented fruit juice using unconventional seasonal fruits through batch fermentation

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ABSTRACT
Fermented fruit juice have high expression in the market in situations where the characteristic aroma and flavour of the material that gives rise to them are often preserved after processing. The current study mainly is focused on cocoa seeds, jammun (Eugenia jambolana), tender arecanut using different variety of yeast like wine yeast and wild yeast from dhataki flowers. Different concoctions of these fruits were considered like areca with beetroot and betel leaf, jackfruit. The study focused on investigating parameters like total and residual sugar, pH, fixed acidity and ethanol concentration. Fixed acidity in terms of tartaric acid equivalent was found to be in the range of 0.60g/L to 6.90g/L. Residual sugar concentration was found to be between 2.05 to 3.85g/L and maximum ethanol content was found to be 11.69%(v/v).

INTRODUCTION

Fermentation in food processing is the conversion of carbohydrates to alcohols and carbon dioxide or organic acids using yeasts, bacteria or a combination thereof, under anaerobic conditions. Fermentation usually implies that the action of micro-organisms is desirable. The science of fermentation is also known as "zymology". Natural fermentation precedes human history. Since ancient times, however, humans have been controlling the fermentation process. The earliest evidence of an alcoholic beverage, made from fruit, rice and honey, dates back to 7000-6600 BCE, in the Neolithic Chinese village of Jaihu. A fermentation is influenced by numerous factors, including temperature, pH, nature and composition of the medium, dissolved oxygen and dissolved carbon dioxide, operational system (ex: Batch, fed batch, continuous), feeding with precursors, mixing (cycling through varying environments), and shear rates in the fermenter. Variations in these factors may affect: the rate of fermentation; the product spectrum and yield; the organoleptic properties of the product (appearance, taste, smell and texture); the generation of toxins; nutritional quality; and other physiochemical properties [1]. Jammun *(Eugenia jambolana L.)* berry is oblong, ovoid and shining crimson black. Jammun fruits are universally accepted to be very good for medicinal purposes, especially for curing diabetes, because of its effect on the pancreas. The fruit and its juice, and the seed contain a biochemical called 'Jamboline', which is believed to check the pathological conversion of starch into sugar in case of increased production of glucose in the body. Besides, the Jammun fruit is a food remedy for bleeding piles and correcting liver disorders [2]. Cocoa is best known for its derived products like chocolates. The seed is comprised of two main parts, namely the testa and the cotyledon. During the fermentation process, the enzyme–substrate biological barriers break down and allow free mixing of the enzymes and the substrates, which produce the important flavour and aroma precursors of chocolate [3]. Areca nut is one of the most important commercial crops in the Southeast Asia. The practice of chewing the areca nut, either alone or in combination with betel leaves to increase the production of saliva and gastric juices or thus aid in digestion. It also strengthens the gums and the teeth and cleanses and deodorizes the mouth. It is also an appetizer and stimulant. Areca nut is used against leucoderma, leprosy, cough, fits, worms, anemia and obesity, as a purgative and as a stimulant and as an appetizer [4]. Jackfruit (*Artocarpus heterophyllus Lam*) trees belong to the family *Moraceae*. There are 2 main varieties of jackfruits: one is small, Fibrous, soft, and mushy, and the carpel's are sweet, with a texture like that of a raw oyster the other variety is crisp and crunchy, but not very sweet. Pureed jackfruit is also manufactured into baby food, juice, jam, jelly, and base for cordials. Jackfruits are made

into candies, fruit-rolls, marmalades, and ice cream. Various parts of the jackfruit tree have been used in medicine [5].

MATERIALS AND METHODOLOGY

Preparation of must

For the preparation of fermentation must, the fruit pulp and seeds was cut into small pieces and ground to uniform slurry by pestle mortar. The pulp slurry was further diluted with distilled water to reduce the turbidity [6]. The pH and the sugar content are adjusted before fermentation. The extract is then pastuerized at 70 to 80˚C and then stoppered with cotton plug. Various combination of must has been given in Table 1.

Table 1: Combinations of must

Name	A	B	C	D	E	F	G
Components	Jammun	Cocoa	Areca+ Beetroot	Areca+ Betel	Areca+ Betel+ Dhataki	Jackfruit Boiled	Jackfruit Unboiled

Inoculation

For the fruit samples to be fermented two different varieties of yeast was used. One being cultured yeast *Saccharomyces cerevisiae* and the other yeast used was the wild species present in Dhataki flower. Inoculation of the culture yeast into the samples depends on the time at which the yeast enters log phase. This is determined in the growth kinetics.

Fermentation

After the inoculation in aseptic conditions, the extract is subjected for fermentation. It is kept in incubator shaker at a temperature of 31˚C, 100rpm for a span of 3-4 days.

Soluble solid (sugar)

Hydrometer was used for the determination of initial sugar. The concentration was expressed in terms of °Brix. To bring the sugar concentration to required value chaptalization was carried out [7,8].

pH measurement

The initial pH of the sample is measured and adjusted to 3.5 using 0.1N HCl or 0.1N NaOH. . The pH is also determined after fermentation by pH meter.

Residual sugar estimation

The concentration of residual sugars was estimated by the using the UV Vis spectrophotometer at 540 nm with 3, 5- DNSA reagent [9].

Titratable Acidity

Titratable acidity (TA) was determined by titration of a strong base i.e 0.5N NaOH against 25 ml of sample to an end point of pH 8.2 using potentiometric titration [10].

$$TA\ (g/L) = 75 \times N \times (T/S) \quad (1)$$

Where N is the normality of NaOH, T is the titer volume (in ml), S is the sample volume (in ml), and 75 is a constant.

Volatile acidity

Fermented fruit juice was distilled at 118 °C in order to determine the amount of Volatile acid (VA), 5 ml of distillate was titrated against 0.5N NaOH using phenolphthalein as indicator to determine volatile acid content [11].

Fixed acidity (FA)

$$\text{Total acidity} = \text{Fixed acidity} + \text{Volatile acidity} \quad (2)$$

As per the Organisation of Vine and Wine (OIV) norms FA should not be less than 5g/L

Quantitative estimation of ethanol

Ethanol was determined using potassium dichromate method [12]. 25 ml of centrifuged sample was distilled at 80°C. The distillate was used for ethanol estimation.

RESULTS AND DISCUSSION

Inoculation

The standardization of inoculum size is important as sugar consumption is balanced between biomass development and ethanol production.

Alcoholic fermentation

Yeast as a group of microorganisms has been quantitatively and commercially exploited as a fermentative species to carry out alcoholic fermentation and this has urged many scientists to study the factors

governing its growth, survival and biological activities in different fruit ecosystem. Yeast plays a prominent role in the fermentation, strongly affecting the quality and flavour of the final product. Yeast had its inverting and fermentative property to the various enzymes present in it like sucrose, zymase, maltase, lactase, reductase, carboxylase etc. Different species of yeast behave differently towards various sugars since they contain different types of enzymes.

pH measurement

The pH of the medium is another important parameter for the successful progress of fermentation because it influences yeast growth as well as the ethanol formation besides sensory quality of wine. It is known that a wine with a pH of less than 3.4 presents a notable resistance to bacterial attack. However, in a wine with a pH more than 3.6, the development of harmful microbial flora may occur [6]. pH was measured through pH meter after fermentation and it was found to be between 3 and 5.5.

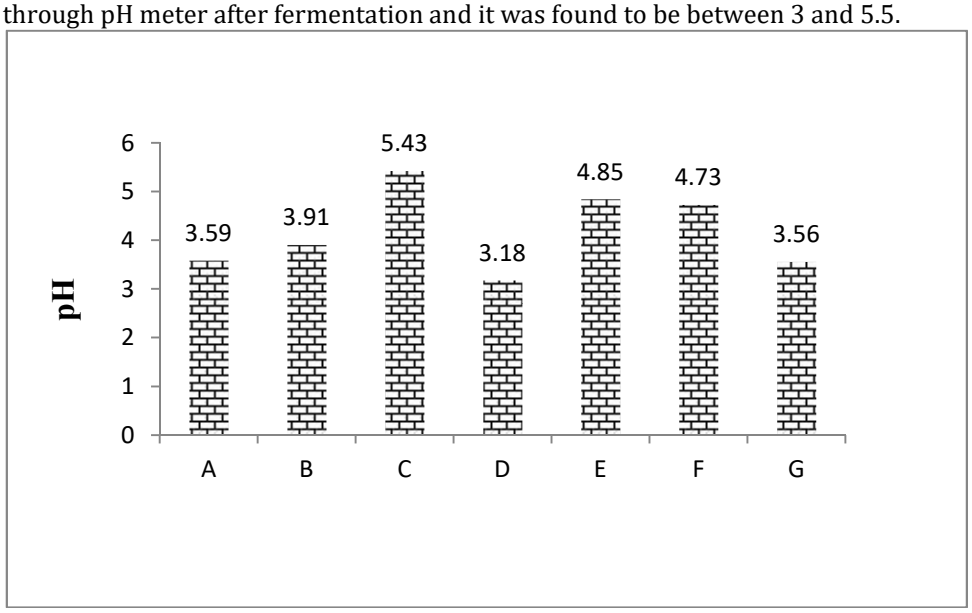

Fig 1: pH profile of various combinations

Acidity

Titratable & Volatile acidity is an asset for the environment to the yeast. Fixed acidity was calculated in terms of tartaric acid equivalents and was found to be highest in jammun (6.90g/L) and lowest in areca nut blended with beetroot (0.60g/L). A and B combinations of wine have FA as per the OIV norms.

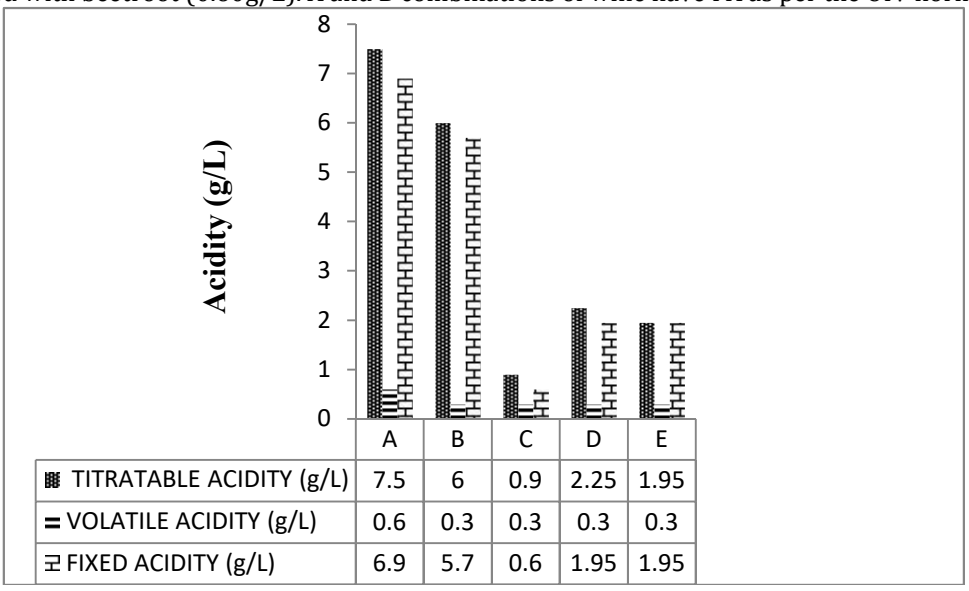

Fig 2: Acidity of different combinations

Residual sugars

The residual sugar concentration of all the samples was found less than 3.1mg/ml and hence there was no contamination at the time of storage.

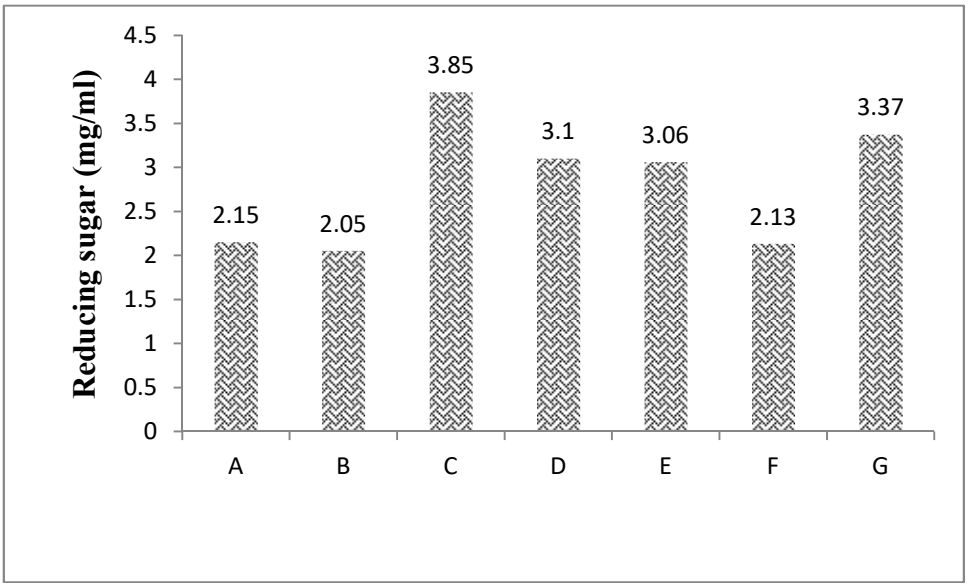

Fig 3: Residual sugar concentration

Ethanol Estimation

The percentage of alcohol sample was found to be in the range of 0.67% to 11.69%. The highest ethanol percentage was found in jackfruit boiled sample and the lowest ethanol percentage was found in areca nut with additive betel leaf where dhataki was used as source of yeast for fermentation.

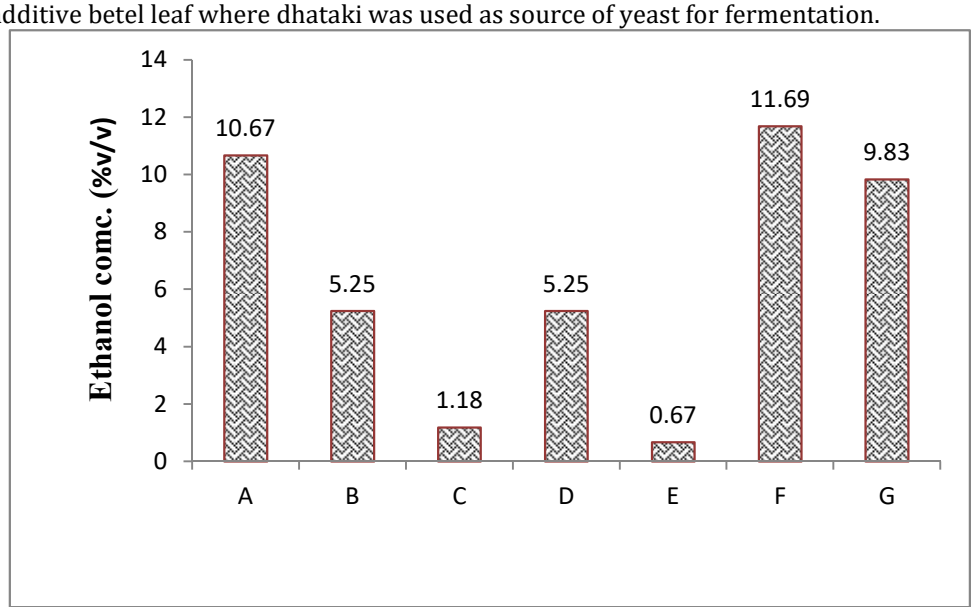

Fig 4: Ethanol concentration

CONCLUSION

After analyzing the fermented samples that was produced from different fruits it was found that the residual sugar concentration was between 2.05 to 3.85g/L and maximum ethanol content was found to be 11.69% in combination F. A, F and G combinations will have higher shelf life. Because of the reduced concentration of reducing sugar & presence of high ethanol content, chances of contamination during storage are stunned, thus increasing shelf life. The fixed acidity was highest in Jammun (6.90g/L) and the lowest in the blend of areca with beetroot (0.60g/L). This parameter can be worked upon for improvement quality of the fermented sample can be improved upon to match the market requirement.

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