Evaluation of litchi juice concentrate for the production of wine

R S Singh* and Preetinder Kaur
Carbohydrate and Protein Biotechnology Laboratory
Department of Biotechnology
Punjabi University, Patiala-147 002, Punjab, India
*Correspondent author, E-mail: rssingh11@lycos.com
Phone: +91 175 3046263(O)
Received 2 April 2009; Accepted 4 June 2009

Abstract
The suitability of litchi [Litchi chinensis (Gaertn.) Sonn.] juice concentrate was investigated for the production of litchi wine. The large amount of fermentable sugars (85.20%) and acid content (4.25%) present in litchi juice concentrate were found suitable for its use in wine making. Amongst the four yeast strains screened for alcoholic fermentation of reconstituted litchi juice, Saccharomyces cerevisiae MTCC 178 was found the most potent strain. The optimal alcoholic fermentation of reconstituted litchi juice by S. cerevisiae MTCC 178 was recorded at 25°C, initial pH of must 5.0 and total soluble solids of 24°B with an inoculum level of 10% (v/v). The litchi wine produced from reconstituted litchi juice concentrate under the optimized conditions contained 11.60% (v/v) ethanol, 92 (mg/l) total esters, 124 (mg/l) total aldehydes and 0.78% (v/v) titratable acidity. The sensory evaluation revealed a clean, light amber colour of litchi wine, an attractive aroma of natural litchi fruit and a harmonious wine taste. The quality of wine as shown by the total score was rated as superior.

Keywords: Litchi chinensis, Litchi juice concentrate, Alcoholic fermentation, Wine, Ethanol.
IPC code; Int. cl.8—C12G 1/00

Introduction
Wine, an alcoholic beverage is prepared by fermenting different fruit juices with appropriate processing and additions1. The conventional process of wine making involves the fermentation of grape juice. However, there are numerous reports available on wine preparation from other fruits such as apple, plum, apricot, pomegranate, strawberry, kinnow, guava, jamun, sapota, litchi2-11, etc. Traditionally, the fruit juice used to be fermented by wild yeast, however, with the developments in the field of genetic engineering, genetically modified strains of Saccharomyces cerevisiae are currently in use for the production of wine. The quality of wine is known to depend upon a number of factors like cultivars and their characteristics such as adequate sugar level, acid content, colour and aroma12. The method of wine production also affects the quality of wine13.

Litchi [Litchi chinensis (Gaertn.) Sonn.] is a nourishing and flavourful fruit which grows in tropical and subtropical areas. All over the world, the major growing countries are India, China, Vietnam, Thailand, South Africa, Australia, USA and the Malagasy Republic, etc. The current post-harvest processing of litchi is carried out for the production of juice, concentrated juice, canned and dry fruit11. The scientific research on litchi or its products is only limited to a very narrow aspect perhaps due to restricted cultivation areas. Most of the research reports on litchi are focused on its planting techniques and fruit preservation11. The large amounts of fermentable sugars acid content and strong flavour in litchi juice makes it suitable for wine preparation. But reports in literature on making of wine from litchi juice are very limited14,15. Instead of litchi juice, its juice concentrate can be easily stored allowing wine makers to produce wine throughout the year. Moreover, concentrate is more resistant to spoilage and is less expensive to handle and transport than juice. Present work has been carried out to investigate the suitability of litchi juice concentrate for the production of wine.
Materials and Methods

Yeast culture and their maintenance

Four yeast strains namely *Saccharomyces cerevisiae* MTCC 177, *S. cerevisiae* MTCC 178, *S. cerevisiae* MTCC 179 and *S. cerevisiae* MTCC 180 were procured from Institute of Microbial Technology, Chandigarh. All the cultures were grown at 30°C under agitation (150 rpm) for 24h in glucose yeast extract (GYE) medium containing glucose 2.0%, yeast extract 0.5%, peptone 1.0% and adjusted to pH 5.0. All the strains were sub-cultured on GYE agar slants at fortnight intervals and stored in refrigerator at 4±1°C, until further use.

Procurement of litchi juice concentrate and its characterization

Litchi juice concentrate was procured from a retail shop of Himalayan Vege Fruit Ltd., Parwanoo (H.P., India). The concentrate was analyzed for pH, titratable acidity, total soluble solids (°Brix), reducing and total sugars and glucose, before its utilization for the preparation of wine.

Reconstitution of litchi juice (must)

Litchi juice (must) was reconstituted from litchi juice concentrate by adding distilled water. Its total soluble solids (°Brix) and pH was adjusted to 24 °B and 5.5, respectively (unless otherwise mentioned). Diammonium hydrogen phosphate (0.1%) and SO₂ in the form of potassium metabisulphite (100 ppm) were added to it before fermentation.

Preparation of inoculum

A loop full of each culture was transferred in sterilized, reconstituted litchi juice from juice concentrate. All the cultures were grown at 25°C under agitation (150 rpm) for 48h and 10% (v/v) inoculum (unless otherwise specified) was used for the preparation of wine.

Screening of yeast strains for alcoholic fermentation of reconstituted litchi juice

Reconstituted juice samples (300ml) in 500ml Erlenmeyer’s conical flasks were inoculated with 10% (v/v) inoculum of each culture and incubated at 25 °C for 5 days and thereafter analyzed for ethanol content.

Optimization of fermentation conditions for the preparation of wine

The effect of total soluble solids (20-26°B), initial pH (4.0-5.5), temperature (20-25°C) and inoculum size (8-14% v/v) on alcoholic fermentation of reconstituted litchi juice by *S. cerevisiae* MTCC 178 was investigated.

Production of wine from reconstituted litchi juice under optimized conditions

Four litres of reconstituted litchi juice (24°B and pH 5.0) supplemented with diammonium hydrogen phosphate (0.1%) and SO₂ in the form of potassium metabisulphite (100 ppm) was taken in 5 litre Erlenmeyer’s flask in duplicates. The flasks were inoculated with 10% (v/v) of 48 h old yeast culture and incubated at 25°C for 5 days. Thereafter, siphoning/racking and filtration were carried out. The prepared wine was filled into clean glass bottles up to the brim and preserved with 50 ppm of SO₂ in the form of potassium metabisulphite, for maturation. The matured wine was pasteurized for 20 min at 62-65°C. Apart from sensory evaluation, the wine was otherwise analyzed for total soluble solids (°Brix), residual sugars, ethanol, total esters, total aldehydes, titratable acidity and pH.

Physico-chemical analysis

The total soluble solids (°Brix) were measured using a hand held refractometer (Erma, Japan). The pH was determined on a pH meter (Jencons, USA). Total sugars were estimated by anthrone method. Reducing sugars were estimated by dinitrosalicylic acid method. Glucose was assayed colorimetrically with GOD-POD enzymatic kit (J. Mitra, New Delhi, India). Titratable acidity (as per cent of tartaric acid), total esters and total aldehydes were estimated by the method of AOAC. Ethanol in wine was measured colorimetrically as described by Caputi et al.

Sensory evaluation

The sensory evaluation of wine was conducted by a taste panel of 5 semi-trained judges. Chilled samples of wine were given to each member and they were asked to rinse their mouth before or in between tasting the given sample. Wine was evaluated for various quality attributes on the prescribed performa.

Results and Discussion

Physico-chemical characterization of litchi juice concentrate

Physico-chemical characteristics of the juice are as follows: total sugars, reducing sugars and glucose were, 88.50, 85.25 and 48.15%, respectively in litchi juice concentrate. Total acid content,
titratable acidity (% citric acid, v/v) was 4.25% and pH 3.1. Total sugars and total acids are the two main factors which are considered for the production of wine from any fruit juice. The large amount of fermentable sugars (85.25%) and acid content (4.25%) in the litchi juice concentrate were found quite suitable for its use in making wine. It has been reported that litchi juice contains very high amount of vitamin C and minerals as compared to other fruit juices. Generally, juice concentrates have many advantages over single strength juices. Storage, handling and transport of concentrates are less expensive as compared to juices. Moreover, the concentrate is resistant to microbial spoilage and its shelf-life is more.

Screening of yeast strains for alcoholic fermentation of reconstituted litchi juice

The amount of ethanol produced from reconstituted litchi juice by different strains of \( S. \) \( cerevisiae \) was quite variable (Fig. 1). Amongst the four strains (MTCC 177, MTCC 178, MTCC 179, MTCC 180) of \( S. \) \( cerevisiae \) screened for alcoholic fermentation of litchi juice, \( S. \) \( cerevisiae \) MTCC 178 showed the maximum (10.25%, v/v) production of ethanol. This strain was, therefore, selected for further studies. The fermentation potential of each organism varies from strain to strain and also depends upon the type of the substrate used for fermentation.

Effect of alcoholic fermentation of reconstituted litchi juice by \( S. \) \( cerevisiae \) with total soluble solids as a function

The total soluble solids of the reconstituted litchi juice were varied from 20-26 (°B), to study its influence on alcoholic fermentation. An increase in ethanol production was recorded with the increase in total soluble solids up to 24°B and thereafter, no change was recorded for this parameter (Fig. 2). Therefore, 24°B was considered optimal for further experimentation. The maximum ethanol production has been reported in juice with 24°B after 5 days of kinnnow juice.
Effect of alcoholic fermentation of reconstituted litchi juice by *S. cerevisiae* with temperature as a function

Alcoholic fermentation of litchi juice was carried out for 5 days at a temperature range of 20-30°C. The maximum ethanol production was recorded at a temperature range of 25-30°C (Fig. 4). Comparatively, ethanol production was lesser at 20°C than at other temperature tried. Therefore, a temperature of 25°C has been selected for further studies. Maximum ethanol production from kinnow juice has been reported at 30°C. However, technology of low temperature (13-16°C) and long fermentation time has been used for making of litchi wine\(^\text{11}\). It has been reported that when the fermentation temperature is between 10-15°C, most of the main aromatic compounds that endow the products with wine character can be preserved\(^\text{22}\).

Effect of alcoholic fermentation of reconstituted litchi juice by *S. cerevisiae* with inoculum size as a function

The results presented in Fig. 5 depict the effect of inoculum level of *S. cerevisiae* on ethanol production in litchi juice. Ethanol production was increased with the increase in inoculum concentration up to 10% for a fermentation period of 5 days. A slight decrease in ethanol production was recorded beyond inoculum level of 10%. An inoculum level of 10% has been
reported optimal for the production of kinnow wine.

Physico-chemical characteristics of litchi wine produced under optimized fermentation conditions

The wine contained 11.60% (v/v) ethanol, 3.50% (w/v) residual sugars and total soluble solids (TSS) was 5°B. Ethanol is the key component on which the type of wine can be characterized. Table wines usually contain 11-14% alcohol and may have as low as 7 per cent. The ethanol content in wine is influenced by method of wine preparation, type of yeast used and initial total soluble solids in must. The low content of residual sugars remained in the litchi wine indicates that almost all the reducing sugars were consumed during fermentation. Total esters and total aldehydes were 92 (mg/l) and 124 (mg/l), respectively. The esters in wines are formed as a result of reaction of alcohols with the respective acids. Total esters in various wines reported vary in between 200-400 (mg/l) as ethyl acetate. Esters in general have fruity and floral impact characteristics that are important in sensory property of wine. The amount of tannins in wines vary in between 100-200 (mg/l) depending upon the type of wine, yeast fermentation conditions, containers and the maturation period. Fruit wine aroma, widely considered to be a key aspect of quality, is the result of interaction between components of the fruits themselves and those produced during processing, fermentation and ageing and the consumers sense of smell. Titratable acidity of litchi wine was 0.78 % and pH, 3.05. Titratable acidity of any fruit wine is an important characteristic varying between 0.5-1.0%. The acidity of fruit wine is dependent upon a number of factors like type of fruit, method of preparation and type of yeast used.

Sensory evaluation

The sensory evaluation report reveals that the litchi wine was clean and of light amber colour. It was having a beautiful and plummy aroma of natural litchi fruit and a harmonious wine taste. In terms of the total score the wine has been evaluated as of superior quality.

Conclusion

The high quality wines should have a characteristic bouquet and taste which depends on the cultivar, maturity and phytochemical conditions of the litchi fruit, pedoclimatic conditions and most importantly, on yeast fermentation physiology. All these factors cause the differences of aroma, fragrance, composition and quality among all kinds of fruit wines.

Acknowledgements

Authors are thankful to the Head, Department of Biotechnology, Punjabi University, Patiala for providing necessary laboratory facilities to execute this work.

References

2. Sandhu DK and Joshi VK, Technology, quality and scope of fruit wines especially apple beverages, Indian Food Ind, 1995, 11(1), 24-34.
3. Joshi VK, Sharma PC and Attri BL, Studies on deacidification activity of...


