The Pharma Innovation Journal 2023; 12(12): 1018-1025

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(12): 1018-1025

www.thepharmajournal.com
Received: 03-10-2023
Accepted: 13-11-2023

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# Studies on jackfruit and kokum blended wine

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## Abstract
The experiment was laid out in Completely Randomized Design with eight treatments and three replications by blending jackfruit and kokum natural juices. When analysing the chemical composition of kokum juice and jackfruit pulp, kokum juice had a lesser percentage of titratable acidity, ascorbic acid, anthocyanin, protein, tannin, and pectin, while jackfruit pulp had the largest percentage of T.S.S., reducing sugars, and total sugars with pH. T.S.S. and pH were found to be decreased throughout must fermentation; T.S.S. and pH were adjusted to 24 $^0$Brix and remained natural, with the exception of treatment $T_8$, where pH was adjusted to 3.5. The range of wine recovery from must is between 64 and 92 percent. The yeast count increased until the fourth day, at which point it began to decline. Regarding the chemical composition of wine treatment $T_5$ and $T_8$ had the lowest T.S.S., while $T_8$ had the lowest reducing sugars, total sugars, tannin, and alcohol. Treatment $T_7$ had the highest titratable acidity, ascorbic acid, anthocyanin, and protein levels. Lowest pH was recorded by treatment $T_7$. Treatment $T_1$ had the lowest pectin content. Treatment $T_4$ has the highest overall sensory score. Treatment $T_4$ had the highest B:C ratio, followed by $T_2$ and $T_3$. As a result, treatment $T_4$ (85% jackfruit pulp + 15% kokum juice) was found to be the best among the various treatments under study.

**Keywords:** Jackfruit pulp, kokum juice, blended wine, must

## Introduction
The Moraceae family includes the jackfruit tree (*Artocarpus heterophyllus* L.). Scientists suggest that Malaysia might be the true jackfruit origin. In India, jackfruit is grown on 1,87,000 Ha of land, with 18,77,000 MT of fruit produced overall (Annon., 2021) [5]. The jackfruit's main economic product is its fruit, which is consumed when it is ripe or unripe. Since its green, unripe condition is so similar to that of chicken. People often call jackfruit in brine "vegetable meat." Pureed jackfruit has been a staple in many recipes, including ice cream, baby food, juice, jam, jelly, candies, fruit rolls, marmalades, and jackfruit leather.
The tropical spice tree kokum (*Garcinia indica* Choisy) grows in India's Western Ghats. The Konkan region grows kokum on an area of around 1000 hectares, generating about 4500 MT of fruit annually, according to a baseline assessment carried out in 2010 (Annon., 2012) [3]. Because kokum fruit contains garcinol and hydroxy citric acid (HCA), it lowers cholesterol. Kokum is used to make several different items, including butter, powder, jam, pickles, dried rind (Amsul), nectar, and jam. To appeal to consumers, the art of blending entails producing products with a variety of colours, scents, astringency levels, and tastes. Kokum fruit may be used to manufacture wine and spirits, making it a great substitute for grapes in the wine industry. As a result, it was thought that kokum fruits ought to be utilised to make wine. Since kokum juice has a more intense colour and higher acidity, it can be used to make wine by diluting the juice and adjusting the must's pH to reduce colour and acidity and produce a respectable amount of high-quality wine with low alcohol. Jackfruit is low in calories and high in sugar. It is high in potassium and contains a considerable number of antioxidants. Due to its high antioxidant activity, jackfruit wine may be beneficial to health; in fact, research indicates that wine's ability to promote health is a result of its antioxidant content. Production of kokum and jackfruit has significantly expanded in the Konkan region. Jackfruit has a low acidity level and is a strong source of antioxidants and potassium. Kokum is utilised for blending in value addition because of its high acidity and natural colour.

## Materials and Methods

The experiment "Studies on jackfruit (*Artocarpus heterophyllus* L.) and kokum (*Garcinia indica* Choicy) blended wine" was laid out in Completely Randomized Design with eight treatments *viz*., $T_1$ - (100% jackfruit pulp), $T_2$ - (95% jackfruit pulp + 5% kokum juice), $T_3$ - (90% jackfruit pulp + 10% kokum juice), $T_4$ - (85% jackfruit pulp + 15% kokum juice), $T_5$ - (80% jackfruit pulp + 20% kokum juice), $T_6$ - (75% jackfruit pulp + 25% kokum juice), $T_7$ - (70% jackfruit pulp + 30% kokum juice), $T_8$ - (100% jackfruit pulp) and three replication. For this investigation fruits of jackfruit and kokum were collected from the nursery no.4 of Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth. Jackfruit pulp was prepared from deseeded bulbs (Fig.1). For extraction of juice from kokum fruit stalks were removed and then fruits were cut with kokum cutter machine and rind and seeds are separated. Pulp was prepared from rind by using heavy duty mixer and from this pulp juice was extracted (Fig.2).

The must was prepared by adding 0.1 percent pectinase to the jackfruit pulp and kept for 2 hours. Then pulp was diluted with distilled water in 1:1 proportion. Then prepared juice of both the fruits was blended as per treatment details and 1 kg of blended juice was taken. The T.S.S. of blended pulp was adjusted to 24°B with the help of sugar. After adjustment of sugar, the pH of the juice was kept natural except $T_8$ where pH was adjusted to 3.5. The prepared must was inoculated with yeast culture after an hour by adding potassium metabisulphite (KMS) @ 30 mg per kg of juice and fermentation was allowed to continue till the must shows constant T.S.S.(Fig.3). The prepared wine was evaluated for their chemical composition and organoleptic properties immediately after preparation.

Total soluble solids (T.S.S.) were determined by using Hand refractometer (Erma Japan, 0 to $32^0$B). Reducing sugars (%), total sugars (%), titratable acidity (%) and tannin (%) content of wine were determined by using methods described by Ranganna (1997) [16]. The pH of wine was determined with the help of pH meter. (Model Systronics µ pH system 361). Ascorbic acid (mg/100 ml), pectin (%) and anthocyanin (mg/100 ml) content of wine were determined by using methods described by Ranganna (1986) [15]. The nitrogen content of wine was estimated by Kjeldahl method using Pelican kelplus equipment. Crude protein was calculated by multiplying with a factor 6.25 (A.O.A.C., 1990). The alcohol content in wine was determined by the method as reported by Natu *et al*. (1995) [18]. Sensory evaluation of wine was done by scoring wine numerically on a 20point score card under six categories of sensory quality. Statistical analysis of the wine was carried out by standard method of analysis of variance described by Panse and Sukhatme (1995) [13].

## Results and Discussion

The data regarding chemical composition of jackfruit and kokum natural juice is presented in the Table 1. The jackfruit and kokum juice used for preparation of must contained T.S.S., reducing sugars, total sugar, pH, titratable acidity, ascorbic acid, proteins, tannins, pectin and anthocyanin are 26 $^0$Brix and 9.5 $^0$Brix, 7.81 and 3.26 percent, 17.85 and 5.20 percent, 4.84 and 2.02, 0.30 and 4.84 percent, 9.6 mg/100 ml and 66.2 mg/100 ml, 0.92 and 1.6 percent, 0.5 and 0.9 percent, 1 and 3 percent, 33 mg/100 ml and 3573 mg/100 ml, respectively. Similar findings in chemical composition of jackfruit have been recorded by Jadhav (2017) [8] while studying wine preparation from jackfruit. In case of chemical composition of kokum fruit juice results were analogous with Haldankar *et al*. (2005) [7] and Chate *et al.* (2019) [6]. Data regarding to chemical composition of must is presented in Table 2 results were found to be non-significant with respect to T.S.S. Similar results found by Jadhav (2017) [8] while studying on preparation of jackfruit wine. The acidity was found to have increased from $T_1$ (0.31%) to $T_7$ (1.06%) in the case of titratable acidity. When compared to other treatments, treatment $T_7$'s highest acidity (1.06%) was significantly higher. Perhaps as a result of an increase in kokum juice percentage from $T_1$ (0%) to $T_7$ (30%), acidity increased from $T_1$ (0.31%) to $T_7$ (1.06%). While investigating how to prepare blended wine from diluted banana and kokum juice, Nevase (2021) [11] reported similar results. In case of pH results found to be significant. The pH of the must decreased from $T_1$ (4.80%) to $T_7$ (3.24%). Highest pH recorded by treatment $T_1$ (4.80) and lowest by $T_7$ (3.24) which was superior over others. While studying the preparation of blended wine from diluted banana and kokum juice, Nevase (2021) [11] found similar results.

The data regarding to the changes in T.S.S during fermentation is given in Table 3. The fermentation was found to be most active during first 4$^{th}$ days as indicated by a rapid fall in T.S.S. However, T.S.S. rapidly declines until the fourth day of fermentation; after that, the rate of fermentation decreased and persisted until the end of fermentation at a significantly slower rate. However, the T.S.S. content remained unchanged after the 10$^{th}$ day. T.S.S. decreased from $T_1$ (10.0 $^0$Brix) to $T_5$ (7.8 $^0$Brix). The maximum reduction in T.S.S. of must was recorded by $T_5$ and $T_8$ (7.6 $^0$Brix). The results correspond with Nevase (2021) [11] research on blended wine made from diluted banana and kokum juice as well as sapota wine.

Table 4 contains information about pH changes that occur during fermentation. The pH of the must decreased continuously as the fermentation process went on until it was finished. The pH data indicates that a decrease in must pH from $T_1$ (3.25) to $T_7$ (2.38) at the end of fermentation was caused by the initial preparation of must, which raised the percentage of kokum juice from $T_1$ (0) to $T_7$ (30%). The results correspond with Nevase (2021) [11] who studied on blended wine made from diluted banana and kokum juice.

Table 5 contains information about changes in yeast count during fermentation. The yeast count increases rapidly until the 4$^{th}$ day before subsequently declining until the fermentation reaches the 12$^{th}$ day. At the end of fermentation (12$^{th}$ day) highest yeast count was recorded by treatment $T_1$ (60 x $10^3$) followed by treatment $T_2$ (40 x $10^3$). Whereas lowest yeast count was recorded by treatment $T_6$ (21 x$10^3$) followed by $T_8$ (22 x $10^3$) and $T_8$ (20 x $10^3$). Kolambe (2018) [10] in soft flesh jackfruit wine and Pawaskar (2016) [14] in kokum wine reported similar results.

The data related to percent wine recovery of jackfruit-kokum blended wine is shown in Table 6. The percent wine recovery shows increasing trend from $T_1$ (64) to $T_7$ (92%) due to increase in kokum juice percentage from (0) to (30%) and decreased in $T_8$ (68%) as 100 percent jackfruit pulp was used. The highest percent wine recovery was observed in treatment $T_7$ (92%) and lowest in $T_1$ (64). The results for percent wine recovery correspond with Nevase (2021) [11] in a blended wine made with banana and kokum and Jadhav (2017) [8] in jackfruit wine. Data regarding to chemical composition of wine are given in table 7. Concerning T.S.S., wine's T.S.S. content declined from $T_1$ (10 $^0$Brix) to $T_5$ (7.8 $^0$Brix) as the percentage of kokum juice increased from 0% to 20%. From treatment $T_5$ to $T_7$ it was slightly increased i.e. 7.8 $^0$Brix ($T_5$) to 8.2 $^0$Brix ($T_7$). Lowest T.S.S. was recorded by $T_5$ and $T_8$ (7.6 $^0$Brix) and it was at par with $T_4$ (8 $^0$Brix) and $T_6$ (8 $^0$Brix). Treatments $T_5$ and $T_8$ recorded the lowest T.S.S., possibly as a result of improved must fermentation. The maximum T.S.S. was recorded by treatment $T_1$(10 $^0$Brix). Nevase (2021) [11] reported comparable outcomes in a blended wine made from diluted juices of banana and kokum. Reducing sugar content of wine showed decreasing trend from $T_1$ (2.06%) to $T_8$ (0.47%) with increases kokum juice percentage. Lowest reducing sugar was recorded by treatment $T_8$ (0.47%) which was at par with treatment $T_7$ (0.50%), $T_6$ (0.74%), $T_5$ (0.90%), $T_4$ (0.99%) and $T_3$ (1.32%). Nevase (2021) [11] found comparable outcomes when studying the process of producing wine using diluted banana and kokum juice. Treatment $T_1$ recorded the highest reducing sugars (2.06%). The reason for the decrease in reducing sugar with an increase in kokum juice percentage could be attributed to a higher conversion of reducing sugars into alcohol. When the percentage of kokum juice increased, the total sugar content of the wine decreased from $T_1$ (2.24%) to $T_8$ (0.84%). Lowest total sugars content was recorded by treatment $T_8$ (0.84%) which was significantly superior over other treatments. The maximum total sugar content was recorded by treatment T1 (2.24%). Decrease in total sugar with increase in kokum juice percentage. Nevase (2021) [11] found similar results while studying the production of wine from diluted juice of bananas and kokum. With increase in kokum juice percentage acidity increases and pH decreases from $T_1$ to $T_8$. Hence congenial condition of pH (between 3 to 4) required for fermentation is created which helps fermentation. The highest titratable acidity was recorded by treatment $T_7$ (1.08%) which was significantly superior over other treatments. From the Table 7 it is clearly observed that titratable acidity of blended wine increased from $T_1$(0.63) to $T_7$ (1.08%) and then decreased in $T_8$ (0.97%). This increase in acidity may be impact of increasing kokum juice percentage from $T_1$ (0) to $T_7$ (30%). Lowest titratable acidity was recorded by treatment $T_1$ (0.63%). The pH of wine showed decreasing trend from $T_1$ (3.25) to $T_7$ (2.38) with increase in kokum juice percentage from $T_1$ (0) to $T_7$ (30%) and it was increased in $T_8$ (3.14). Lowest pH was recorded by treatment $T_7$ (2.38) which was at par with treatment $T_6$ (2.53) and significantly superior over all others treatments. Highest pH was recorded by treatment $T_1$ (3.25). Acids are inversely related to pH, therefore the reduction in pH with an increase in acidity of wine was observed. Ascorbic acid of wine showed increased trend from $T_1$ (4.68 mg/100 ml) to $T_7$ (14.02 mg/100 ml) with increase in kokum juice percentage from $T_1$ (0) to $T_7$ (30%) and then slightly decreased in $T_8$ (4.88 mg/100 ml) where 100 percent jackfruit pulp was used. Highest ascorbic acid content was recorded by treatment $T_7$ (14.08 mg/100 ml) which was significantly superior than all others treatments. Lowest ascorbic acid content was recorded by treatment $T_1$ (4.68 mg/100 ml). Similar finding reported by Nikhanj *et al*. (2015) [12] while studying fermentative production of guava wine (*Psidium guajava* L.). In case of anthocyanin content of wine with an increase in kokum juice percentage from $T_1$ (0) to $T_7$ (30%) in blended must, the anthocyanin content of wine showed an increasing trend from $T_1$ (10.18 mg/100 ml) to $T_7$ (122 mg/100 ml), and subsequently decreased in $T_8$ (11.75 mg/100 ml) where 100 percent jackfruit pulp was present. Increase in anthocyanin content of wine with an increase in kokum juice percentage was reported by Nevase (2021) [11] in a blended wine made with banana and kokum. The highest anthocyanin content was recorded by treatment $T_7$ (122 mg/100 ml) which was significantly superior over other treatments. Treatment $T_1$ (10.18 mg/100 ml) had the lowest anthocyanin content. The protein content of wine showed increasing trend from $T_1$ (0.30%) to $T_7$ (0.57%) with increase in kokum juice percentage from $T_1$ (0) to $T_7$ (30%) and subsequently decreased at $T_8$ (0.28%) where 100 percent jackfruit pulp was present in blended must. Highest protein content was recorded by treatment $T_7$ (0.57%) which was significantly superior over all others treatments. Lowest protein content was recorded by treatment $T_8$ (0.28%). Similar finding reported by Muotoulu and Mbaeyi-Nwaoha (2020) [10] while studying quality assessment of formulated table wine from blends of Starfruit (*Averrhoa carambola* L.) and peter mango (*Mangifera indica* L.) fruit. When the percentage of kokum juice increased from $T_1$ (0) to $T_7$ (30%), the tannin content of the wine showed an increasing trend from $T_1$ (0.30%) to $T_7$ (0.46%), and then it decreased in $T_8$ (0.25%) when 100% jackfruit pulp was used in the blended must. Lowest tannin content was recorded by treatment $T_8$ (0.25%) was significantly superior over others treatments. Significantly highest tannin content in wine was recorded by treatment $T_7$ (0.46%). Similar results were reported by Sarkale (2012) [19] while studying wine preparation from kokum fruit. When the percentage of kokum juice increased from $T_1$ (0) to $T_7$ (30%), the pectin content of the wine showed an increasing trend from $T_1$ (0.21%) to $T_7$ (0.50%), and then it decreased in $T_8$ (0.20%) when 100% jackfruit pulp was used in the blended must. Lowest pectin content was recorded by treatment $T_8$ (0.20%) which was at par with treatment $T_1$ (0.21%) and $T_2$ (0.24%) and significantly superior over all others treatments. Treatment $T_7$ had the highest pectin content (0.50%). Similar finding reported by Muotoulu and Mbaeyi-Nwaoha (2020) [10] while studying quality assessment of formulated table wine from blends of starfruit (*Averrhoa carambola* L.) and peter mango (*Mangifera indica* L.) fruit. Wine's alcohol percentage increased from $T_1$ (7.3%) to $T_5$ (14.17%), then declined from $T_5$ (14.17%) to $T_7$ (12.40%), and then increased once more in $T_8$ (14.04%). Treatment $T_5$ recorded the highest alcohol content at 14.17%, which was at par with $T_8$ (14.04%). Treatment $T_1$ (7.30%) had the lowest alcohol content because it had the highest T.S.S. at the end of fermentation. A similar finding was reported by Sharma *et al.* (2003) [17] when they investigated strawberry wine's physico-chemical and sensory qualities were affected by maturation.

**Sensory evaluation of jackfruit - kokum blended wine**

Information regarding the sensory assessment of the jackfruit and kokum blended wine is presented in Table 8. A group of 10 judges evaluated the wine made from a blend of jackfruit and kokum juice using a 20-point rating system. Treatment $T_4$ received the highest possible score of 14 for colour and appearance, taste, and astringency; $T_5$ received the highest possible score of 14 for body treatment; and $T_4$ received the highest possible score of 13 for aroma treatment. $T_4$ received the highest rating of 14 out of 20 for overall acceptability and overall quality treatment, which comes under standard wine.

**Cost of production of wine prepared by blending jackfruit and kokum natural juice**

180 ml of blended wine with jackfruit and kokum had the highest production cost in $T_1$ (Rs. 20.40) and the lowest in $T_2$ (Rs. 18). Treatment $T_4$ had the maximum net profit (Rs. 67.24), while treatment $T_7$ had the lowest (Rs. 40). Treatment $T_4$ recorded the highest benefit-cost ratio (4.62), followed by $T_2$ (4.31) and $T_3$ (4.20), with treatment $T_7$ recording the lowest (3.40).

**Table 1:** Chemical composition of jackfruit and kokum natural juice

| Sr. No. | Parameters | Jackfruit pulp | Kokum juice |
|---|---|---|---|
| 1 | T.S.S.($^0$Brix) | 26.0 | 9.5 |
| 2 | Reducing sugars (%) | 7.81 | 3.26 |
| 3 | Total sugars (%) | 17.85 | 5.20 |
| 4 | Titratable acidity (%) | 0.30 | 4.84 |
| 5 | pH | 4.84 | 2.02 |
| 6 | Ascorbic acid (mg/100 ml) | 9.6 | 66.2 |
| 7 | Proteins (%) | 0.92 | 1.6 |
| 8 | Tannins (%) | 0.5 | 0.9 |
| 9 | Pectin (%) | 1 | 3 |
| 10 | Anthocyanin (mg/100 ml) | 33 | 3573 |

**Table 2:** Chemical composition of must prepared by blending jackfruit and kokum juice

| Treatments | | | T.S.S. ($^0$Brix) | Titratable acidity (%) | pH |
|---|---|---|---|---|---|
| | J (%) | K (%) | | | |
| $T_1$ | 100 | 00 | 24.2 | 0.31 | 4.80 |
| $T_2$ | 95 | 05 | 24.0 | 0.33 | 4.20 |
| $T_3$ | 90 | 10 | 24.0 | 0.49 | 4.00 |
| $T_4$ | 85 | 15 | 24.2 | 0.64 | 3.71 |
| $T_5$ | 80 | 20 | 24.0 | 0.80 | 3.45 |
| $T_6$ | 75 | 25 | 24.2 | 0.90 | 3.30 |
| $T_7$ | 70 | 30 | 24.0 | 1.06 | 3.24 |
| $T_8$ | | | 24.2 | 0.98 | 3.50 |
| Mean | | | 24.10 | 0.67 | 3.80 |
| S. Em. (±) | | | 0.04 | 0.007 | 0.011 |
| C.D. at 1% | | | N.S. | 0.029 | 0.047 |

**Table 3:** Changes in T.S.S. ($^0$Brix) during fermentation of the must

| Treatments | 0 Day | 2$^{nd}$Day | 4$^{th}$Day | 6$^{th}$Day | 8$^{th}$Day | 10$^{th}$Day | 12$^{th}$Day |
|---|---|---|---|---|---|---|---|
| $T_1$ | 24.2 | 18.6 | 11.8 | 11.2 | 11.2 | 11.0 | 10.0 |
| $T_2$ | 24.0 | 16.0 | 11.0 | 9.6 | 9.6 | 9.2 | 9.0 |
| $T_3$ | 24.0 | 17.2 | 9.6 | 9.2 | 8.8 | 8.6 | 8.4 |
| $T_4$ | 24.2 | 16.4 | 10.0 | 8.8 | 8.4 | 8.0 | 8.0 |
| $T_5$ | 24.0 | 16.4 | 9.2 | 8.2 | 8.0 | 7.8 | 7.6 |
| $T_6$ | 24.2 | 16.2 | 11.2 | 9.0 | 8.4 | 8.2 | 8.0 |
| $T_7$ | 24.0 | 18.0 | 9.0 | 8.8 | 8.6 | 8.6 | 8.2 |
| $T_8$ | 24.2 | 22.0 | 8.8 | 8.4 | 8.2 | 7.8 | 7.6 |
| Mean | 24.17 | 17.60 | 10.07 | 9.15 | 8.90 | 8.65 | 8.65 |

**Table 4:** Change in pH during fermentation of the must

| Treatments | 0 Day | 2$^{nd}$ Day | 4$^{th}$ Day | 6$^{th}$ Day | 8$^{th}$ Day | 10$^{th}$ Day | 12$^{th}$ Day |
|---|---|---|---|---|---|---|---|
| $T_1$ | 4.84 | 3.96 | 3.80 | 3.70 | 3.50 | 3.43 | 3.25 |
| $T_2$ | 4.26 | 3.80 | 3.63 | 3.50 | 3.46 | 3.33 | 3.16 |
| $T_3$ | 4.00 | 3.76 | 3.53 | 3.49 | 3.30 | 3.10 | 3.10 |
| $T_4$ | 3.76 | 3.60 | 3.52 | 3.40 | 3.30 | 3.28 | 2.88 |
| $T_5$ | 3.50 | 3.36 | 3.20 | 3.14 | 3.10 | 2.90 | 2.71 |
| $T_6$ | 3.35 | 3.20 | 3.18 | 3.10 | 3.10 | 3.06 | 2.53 |
| $T_7$ | 3.20 | 3.13 | 2.79 | 2.66 | 2.54 | 2.45 | 2.38 |
| $T_8$ | 3.50 | 3.40 | 3.30 | 3.28 | 3.16 | 3.10 | 3.14 |
| Mean | 3.79 | 3.50 | 3.36 | 3.28 | 3.18 | 3.08 | 2.80 |

**Table 5:** Changes in yeast count during fermentation of the must

| Treatments | Colony count in number × $10^3$ | | | |
|---|---|---|---|---|
| | 0 day | 4$^{th}$ Day | 8$^{th}$ day | 12$^{th}$ day |
| $T_1$ | 0 | 1760 | 480 | 60 |
| $T_2$ | 0 | 1880 | 540 | 40 |
| $T_3$ | 0 | 1560 | 320 | 31 |
| $T_4$ | 0 | 1430 | 300 | 28 |
| $T_5$ | 0 | 1260 | 280 | 26 |
| $T_6$ | 0 | 860 | 240 | 21 |
| $T_7$ | 0 | 946 | 220 | 25 |
| $T_8$ | 0 | 940 | 310 | 20 |
| Mean | 0 | 1329.5 | 336.25 | 32 |

**Table 6:** Percent wine recovery from blended must of jackfruit and kokum

| | Wine recovery (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Treatments | $T_1$ (100:0) | $T_2$ (95:5) | $T_3$ (90:10) | $T_4$ (85:15) | $T_5$ (80:20) | $T_6$ (75:25) | $T_7$ (70:30) | $T_8$ Control |
| Mean | 64 | 72 | 76 | 79 | 80 | 84 | 92 | 68 |
| S. Em. (±) | 0.957 | | | | | | | |
| C.D. at 1% | 3.95 | | | | | | | |

**Table 7:** Chemical composition of jackfruit and kokum blended wine (T.S.S., reducing sugars, total sugars, titratable acidity and pH, ascorbic acid, anthocyanin, total protein, tannin, pectin and alcohol)

| Treatments | T.S.S. ($^0$Brix) | Reducing sugars (%) | Total sugars (%) | Titratable acidity (%) | pH | Ascorbic acid (mg/100 ml) | Anthocyanin (mg/100 ml) | Protein (%) | Tannin (%) | Pectin (%) | Alcohol (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $T_1$ | 10.0 | 2.06 | 2.24 | 0.63 | 3.25 | 4.68 | 10.18 | 0.30 | 0.30 | 0.21 | 7.30 |
| $T_2$ | 9.0 | 1.77 | 2.08 | 0.70 | 3.16 | 6.06 | 50.92 | 0.33 | 0.32 | 0.24 | 8.90 |
| $T_3$ | 8.4 | 1.32 | 1.98 | 0.75 | 3.10 | 7.00 | 67.46 | 0.37 | 0.34 | 0.32 | 11.30 |
| $T_4$ | 8.0 | 0.99 | 1.77 | 0.78 | 2.88 | 7.40 | 91.64 | 0.40 | 0.36 | 0.36 | 12.74 |
| $T_5$ | 7.6 | 0.90 | 1.66 | 0.80 | 2.70 | 9.40 | 96.63 | 0.46 | 0.37 | 0.38 | 14.17 |
| $T_6$ | 8.0 | 0.74 | 1.37 | 0.90 | 2.53 | 11.73 | 101.10 | 0.52 | 0.42 | 0.42 | 13.74 |
| $T_7$ | 8.2 | 0.50 | 0.96 | 1.08 | 2.38 | 14.02 | 122.00 | 0.57 | 0.46 | 0.50 | 12.40 |
| $T_8$ (Control) | 7.6 | 0.47 | 0.84 | 0.97 | 3.14 | 4.88 | 11.75 | 0.28 | 0.25 | 0.20 | 14.04 |
| Mean | 8.65 | 1.09 | 1.61 | 0.82 | 2.89 | 8.14 | 68.96 | 0.40 | 0.35 | 0.32 | 11.80 |
| S. Em. (±) | 0.11 | 0.21 | 0.02 | 0.01 | 0.05 | 0.08 | 0.28 | 0.01 | 0.01 | 0.01 | 0.10 |
| C.D. at 1% | 0.47 | 0.87 | 0.10 | 0.04 | 0.23 | 0.32 | 1.17 | 0.07 | 0.04 | 0.05 | 0.42 |

**Table 8:** Sensory evaluation of jackfruit and kokum blended wine

| Treatments | Colour & Appearance | Body | Aroma | Taste | Astringency | Overall acceptability | Overall quality (Avg. score) |
|---|---|---|---|---|---|---|---|
| $T_1$ | 10 | 9 | 12 | 11 | 11 | 11 | 11 |
| $T_2$ | 11 | 10 | 12 | 13 | 13 | 12 | 12 |
| $T_3$ | 12 | 11 | 12 | 12 | 13 | 12 | 12 |
| $T_4$ | 14 | 13 | 13 | 14 | 14 | 14 | 14 |
| $T_5$ | 13 | 14 | 12 | 12 | 12 | 12 | 12 |
| $T_6$ | 12 | 11 | 11 | 10 | 11 | 11 | 11 |
| $T_7$ | 11 | 10 | 10 | 11 | 11 | 10 | 10 |
| $T_8$ (Control) | 12 | 12 | 12 | 12 | 10 | 12 | 12 |
| Mean | 12 | 11 | 12 | 12 | 12 | 12 | 12 |
| Grape wine | 15 | 14 | 15 | 15 | 15 | 15 | 15 |

**Table 9:** Cost of production of wine prepared from 1kg must prepared from jackfruit and kokum blended juices

| Treatments | Cost of production 1kg of wine (Rs) | Cost of production 180 ml of wine (Rs) | Sale price / 180 ml bottle (Rs) | B:C ratio |
|---|---|---|---|---|
| $T_1$ | 61.11 | 20.40 | 65 | 3.54 |
| $T_2$ | 64.11 | 18.00 | 70 | 4.31 |
| $T_3$ | 69.51 | 16.47 | 70 | 4.20 |
| $T_4$ | 73.83 | 16.86 | 80 | 4.62 |
| $T_5$ | 75.25 | 16.95 | 70 | 4.13 |
| $T_6$ | 80.03 | 17.17 | 60 | 3.49 |
| $T_7$ | 84.88 | 17.39 | 60 | 3.40 |
| $T_8$ | 62.65 | 17.65 | 70 | 3.97 |

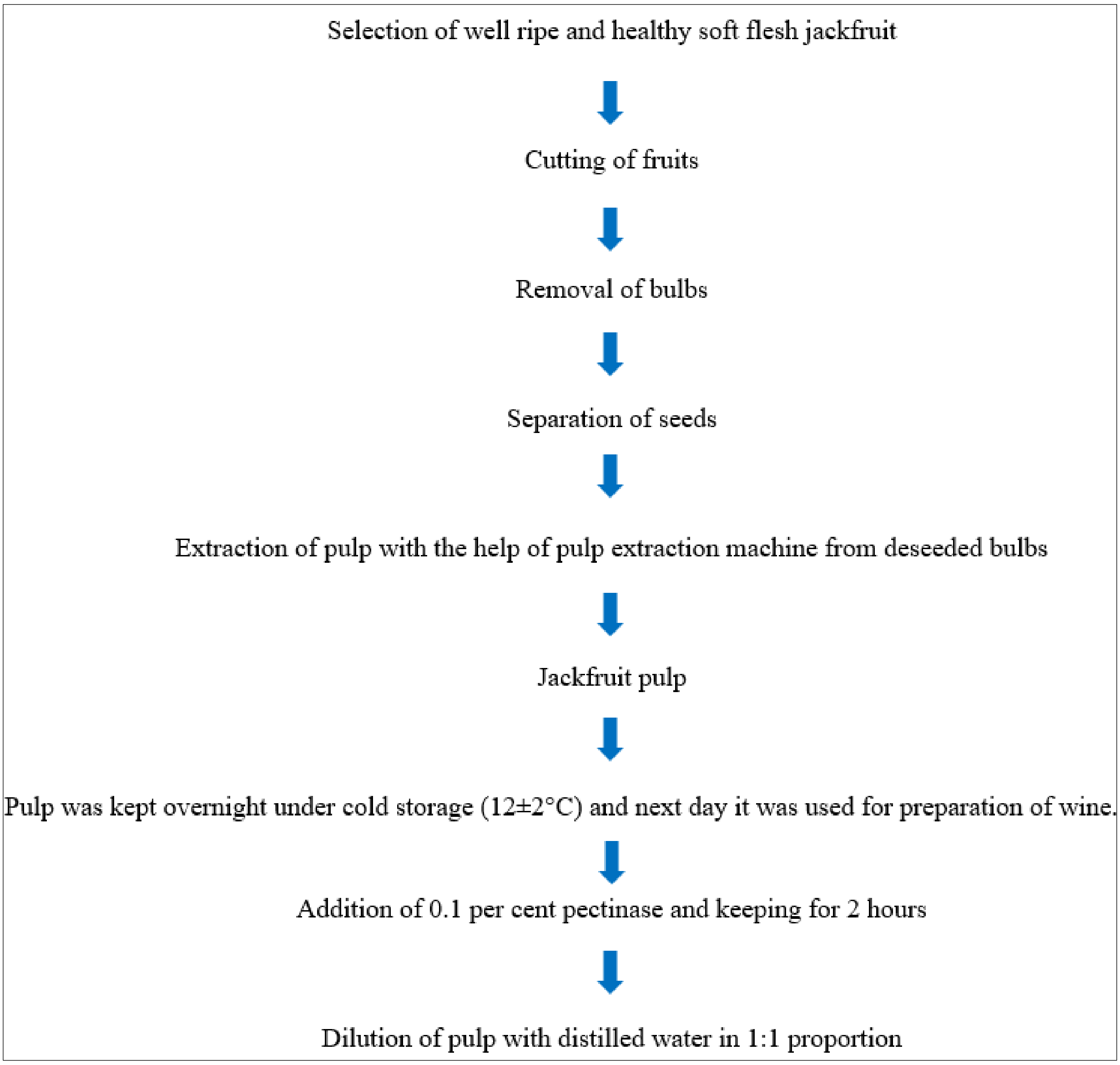


**Fig 1:** Preparation of soft flesh jackfruit pulp for wine

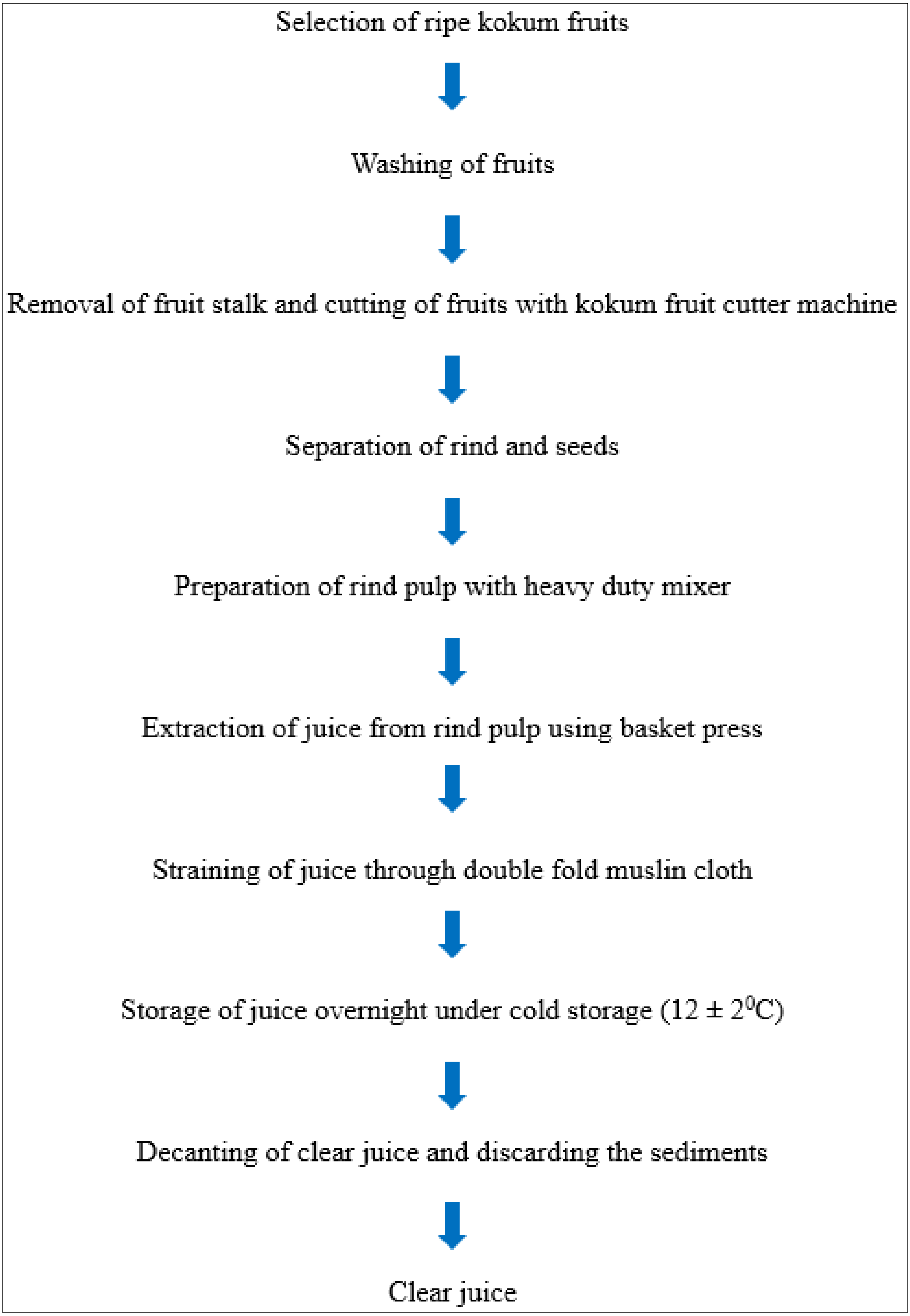


**Fig 2:** Extraction of juice from kokum fruits

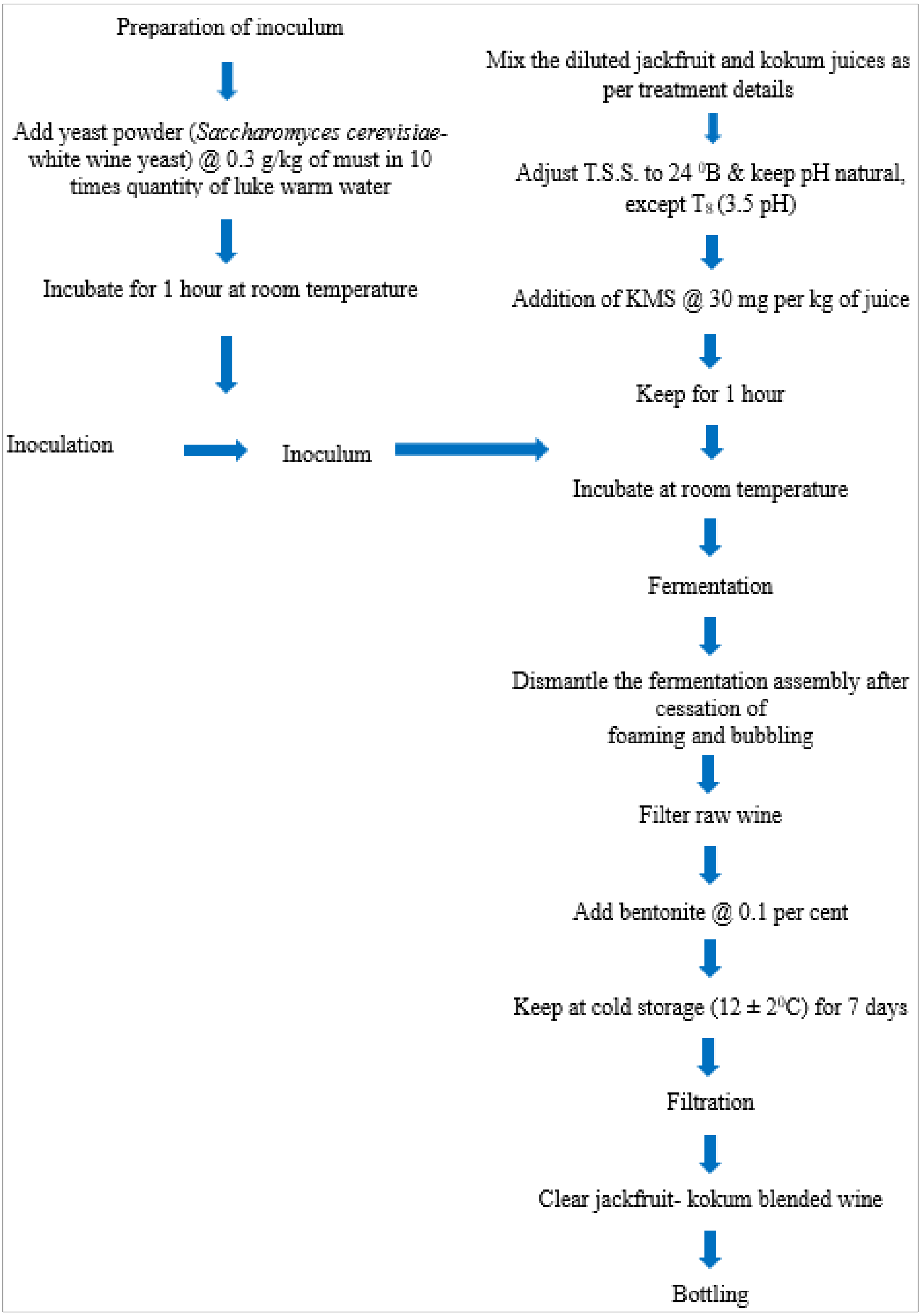


**Fig 3:** Preparation of jackfruit -kokum blended wine

## Conclusion

The results of this study indicate that treatment $T_4$ (85% jackfruit + 15% kokum juice), which has the highest overall quality score (14) and highest B:C ratio (4.62), can produce the best quality standard wine.

## References

1. AOAC. Official Method of Analysis. Association of Official Analytical Chemists, Washington, D.C., 12th Edition; c1975. p. 15-18.
2. AOAC. Official Method of Analysis. Association of Official Analytical Chemists, Washington, D.C., 13th Edition; c1980. p. 376-384.
3. Anonymous. Resource Book on Kokum (*Garcinia indica* Choisy). Western Ghats Kokum Foundation, Panaji – Goa; c2012. p. 6.
4. Anonymous. Resource Book on Kokum (*Garcinia indica* Choisy). Western Ghats Kokum Foundation, Panaji –

Goa; c2014. p. 35.
5. Anonymous. Area production and productivity of jackfruit in India. Horticulture statistics at a glance. National Horticulture Board (NHB), Government of India, Gurgaon, Haryana; c2021. p. 1.
6. Chate MR, Kakde SB, Neeha VS. Kokum (*Garcinia indica*) fruit: A review. Asian J Dairy Food Res. 2019;38(4):329-332.
7. Haldankar PM, Kore VN, Nimbalkar SR. Variability of fruit characters in kokum (*Garcinia indica* Choisy). J Spices Aromatic Crops. 2005;14(1):65-70.
8. Jadhav AP. Study on preparation of jackfruit (*Artocarpus heterophyllus* Lam.) wine. M.Sc. (Agri.) Thesis submitted to Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra; c2017.
9. Kolambe SC. Preparation of wine from soft flesh jackfruit. M.Sc. (Agri.) thesis (unpublished), submitted to Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra; c2018.
10. Muotoulu UF, Mbaeyi-Nwaoha IE. Quality assessment of formulated table wine from blends of Star fruit (*Averrhoa carambola* L.) and peter mango (*Mangifera indica*) Fruits. Am J Food Sci Tech. 2020;8(5):211-225.
11. Nevase MD. Standardization of blended wine from diluted juice of banana and kokum. M.Sc. (Hort.) thesis (Unpublished) submitted to Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra; c2021.
12. Nikhanj P, Kocher G. Fermentative production of guava-wine (*Psidium guajava* L.) using S. cerevisiae. Curr Nutr Food Sci. 2015;11:21-30.
13. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research Publication; c1985. p. 87-89.
14. Pawaskar SA. Studies on storage and wine making technology in kokum fruit. M.Sc. (Agri) thesis submitted to Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra; c2016.
15. Ranganna S. Handbook of analysis and quality control for fruits and vegetable products. 2nd Edn. Tata McGraw Hill Publishing Company Ltd., New Delhi; c1986.
16. Ranganna S. Handbook of analysis and quality control for fruits and vegetable products. 3rd Edn. Tata McGraw Hill Publishing Company Ltd., New Delhi; c1997.
17. Sharma S, Joshi VK. Studied the effect of maturation on the physico-chemical and sensory quality of strawberry wine. J Sci Ind. Res. 2003;62:601-608.
18. March ST, Smith GF. Design and natural science research on information technology. Decision support systems. 1995;15(4):251-66.
19. Sarkale AN, Pawar CD. Effect of TSS and pH levels on chemical composition of kokum (*Garcinia indica*) must and it's fermentation. International Journal of Processing and Post-Harvest Technology. 2012;3(2):291-295.