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Effect of Blending Cashew Apple (*Anacardium occidentale* L.) and Aonla (*Emblica officinalis* Gaertn.) Juice on Quality of Wine During Storage

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The experiment, was carried out in completely randomized design with nine treatments and three replications by blending cashew apple and aonla natural juices. The chemical composition of cashew apple and aonla juice were analysed, value for T.S.S., reducing sugars, total sugars and pH were maximum for cashew apple juice. Aonla juice had a maximum value for titratable acidity, ascorbic acid and tannin content. The must T.S.S. was adjusted to 24 ºBrix and pH kept natural. During fermentation the T.S.S. and pH was found to be decreased and titratable acidity of must was found to be increased. Regarding the chemical composition of wine treatment T_5 (60% cashew apple: 40% aonla juice) had the lowest T.S.S., reducing sugars, total sugars, and alcohol. Treatment T_9 (20 % cashew apple: 80% aonla juice) had the highest titratable acidity, ascorbic acids content. Lowest pH was recorded by treatment T_9. Treatment T_1 (100% cashew apple juice) had the lowest tannin content at both '0' month and '6' months of storage. The T.S.S., total sugars, pH, reducing sugars, ascorbic acid and tannin content of wine reduced during the storage period of six months. On the other hand, pH and alcohol content of wine increased during the storage period of six months. Highest alcohol content was found in treatment T_5 (60% cashew apple: 40% aonla juice) (13.89%) after aging for six months.

Keywords: Cashew apple juice; aonla juice; blended wine; aging.

1. INTRODUCTION

The cashew apple (*Anacardium occidentale* L.) tree generally considered to be native to Eastern Brazil. Cashew (*Anacardium occidentale* L.) belonging to the genus Anacardium of the family Anacardiaceae. The tree bears two types of fruits, most important cashew nutand another one is cashew apple. Cashew apples are rotten and wasted due to lack of proper preservation technique. It contains 261.5 mg/100 g ascorbic acid [1] and 8000 IU/100 g of vitamin 'A' [2]. Cashew apple juice is also reported to contain five times more vitamin 'C' as in citrus juice [3]. Apart from its nutritional importance, therapeutic properties and value-added applications, around 90 per cent of harvest gets wasted and the remaining 10 per cent of harvested is either consumed as fresh or processed into a variety of products such as juices, RTS, syrups, jams, ice cream, vinegar and distilled products [4,5,6]. The alcoholic drink "feni" made in Indian state of Goa using discarded cashew apples [7].

Aonla (*Emblica officinalis* Gaertn.) is one of the important fruit in India. The fruit aonla commonly known as Indian Gooseberry finds a special place in India due to its medicinal value. The family of aonla is Euphorbiaceae and genus Phyllanthus. It is one of the richest source of vitamin C, pectin and tannin which is being used for preparation of various ayurvedic, unani system of medicine [8]. A number of various products such as pickle, murabba, juice, candy, squash, jam, jelly, etc., are prepared from aonla [9]. Aonla is one of the highest source of vitamin C, pectin and tannin. It is highly nutritive and one of the richest source of antioxidants, hence suitable for wine preparations. The aonla fruits has high acidity and astringent taste, not palatable for direct consumption therefore it is mainly consumed only after processing.

Wine is a beverage resulting from fermentation of fruit juice by yeast with proper processing and additive. Wine from cashew apple juice can be good for health as it has good antioxidant activity and various studies reported that wine is healthy due to the presence of antioxidants in them. Cashew apple is widely available in India and nearly about 90 per cent fruits goes waste due to its improper utilization and exploitation. It is highly nutritive and good source of antioxidants, hence suitable for wine preparations. The aonla fruits, because of its high acidity and astringent taste, not palatable for direct consumption therefore it is mainly consumed only after processing. Wine is a beverage resulting from fermentation of fruit juice by yeast with proper processing and additive. Different fruits might be used to produce highly palatable wines. Wine consist of both alcohol and antioxidants, therefore it is a unique drink. Due to their low alcohol content, they do not cause any severe inebriation. If blended wine prepared from highly acidic aonla and low acidic cashew apples fruits, the prepared wine will be nutritionally rich and helpful for good health of peoples.

2. MATERIALS AND METHODS

The research entitled"Studies on cashew apple (*Anacardium occidentale* L.) and aonla (*Emblica* *officinalis* Gaertn.) blended wine"" was set out in Completely Randomized Design with nine treatments viz.T_1 - (100% cashew apple juice), T_2 - (90% cashew apple juice + 10% aonla juice), T_3 - (80% cashew apple juice + 20% aonla juice), T_4 - (70% cashew apple juice + 30% aonla juice), T_5 - (60% cashew apple juice + 40% aonla juice), T6 - 50% cashew apple juice + 50% aonla juice), T7 - (40% cashew apple juice + 60% aonla juice), T8 - (30% cashew apple juice + 70% aonla juice), T9 –(20% cashew apple juice + 80% aonla juice) and three replication.Fruits of cashew apple and aonla for this experiment were collected from the Central Experiment Station, Wakavali of Dr.Balasaheb Sawant Konkan Krishi Vidyapeeth.Juice from cashew apples were extracted from helicoidal juice extractor machine (Fig. 1). The juice of aonla fruits extracted by following two steps, fruits were shredded with aonla shredder and then juice were extracted from shredded aonla with the help of basket press (Fig. 2). Then juice of both the fruits was mixed as per treatment details and 1 kg of blended juice was taken. With the help of sugar the T.S.S. of blended juice was adjusted to 24 ° Brix and the pH of the juice was kept natural. The prepared must was inoculated with yeast culture (*Saccharomyces cerevisiae*) @ 0.3g/kg of must after an hour and fermentation was allowed to continue till the must shows constant T.S.S. at room temperature (Fig. 3). The prepared wine was evaluated for their chemical composition immediately after preparation and after six months of storage. Total soluble solids (T.S.S.) were determined by using Hand refractometer (Erma Japan, 0 to 320B). Reducing sugars (%), total sugars (%), titratable acidity (%), ascorbic acid (mg / 100ml) and tannin (%) content of wine were determined by using methods described by Ranganna [10]. The pH of wine was determined with the help of pH meter. (Model Systronics µ pH system 361). The alcohol content in wine was determined by the method as reported by Natu et al. [11].

3. RESULTS AND DISCUSSION

The data regarding chemical composition of cashew apple and aonla natural juice is presented in the Table 1. The cashew apple and aonla juice used for preparation of must contained T.S.S., reducing sugars, total sugar, pH, titratable acidity, ascorbic acid and tannins are 12.8 º Brix and 10.4 º Brix, 7.43 and 5.27 per cent, 10.34 and 7.05 per cent, 3.70 and 2.60, 0.35 and 2.35 per cent, 225 and 455 mg/100 ml and 1.75 and 2.33 per cent, respectively. Similar findings in chemical composition of cashew apple have been recorded by Damasceno et al. [12] and Anand et al. [13]. In case of aonla, similar results have been shown by Kulkarni et al. [14] and Singh et al. [15]. The T.S.S. of must of all the treatments were adjusted to 24 º Brix. The titratable acidity of must was found to have increased from T_1 (0.30 %) to T_9 (1.04 %) may be due to an increase in aonla juice percentage from T_1 (0 %) to T_9 (80 %). Similar results have been recorded by Sadgir [16] while working on cashew apple and pineapple blended wine. The pH of must decreased from T_1 (3.98) to T_9 (2.65) due to increase in acidity from T_1 (0.30 %) to T_9 (1.04 %). As acids are inversely proportional to pH. Nevase [17] found comparable outcomes when studying the process of producing wine using diluted banana and kokum juice. According to the data shown in Table 3, lowest T.S.S. was recorded by T_5 (6.28 ^{0} Brix) due to better fermentation and it was at par with T_4 (6.76 ^{0} Brix) at '0' month storage. Lowest T.S.S. is recorded by treatment T_5 may due to better fermentation of must. The maximum T.S.S. was recorded by treatment T_9 (10.63 ^{0} Brix). After six months of storage, similar trend was observed in T.S.S. as it is shown at the start of the storage (0 month). Lowest T.S.S. was recorded by T_5 (5.93 ^{0} Brix) due to better fermentation and it was at par with T_4 (6.30 ^{0} Brix) and T_6 (6.36 ^{0} Brix). The T.S.S. mean values dropped from 7.81 ^{0} Brix at 0 month to 7.23 ^{0} Brix at the end of six months of storage. The small reduction in T.S.S. could be the outcome of micro-fermentation during storage, which might have converted sugars into alcohol. Decrease in T.S.S. during storage were reported by Akinwale [3] in cashew apple wine and Flory et al. [18] in blood fruit and aonla fermented beverages.

At '0' month lowest total sugar content was recorded by treatment T_5 (1.16 %) which was significantly superior over other treatments. The maximum total sugar content was recorded by treatment T_9 (1.82 %). After six months of storage, blended wine showed the same trend of total sugars as that of initial stage of storage (0 month). Lowest total sugar content was recorded by treatment T_5 (0.96 %) which was significantly superior over other treatments and at par with T_4 (1.05 %). The maximum total sugar was recorded by treatment T_9 (1.77 %) which having high T.S.S. content (9.23 ^{0} Brix) at the end of 6 months storage. The data regarding chemical composition of aged wine (6 months storage) showed slightly decreasein total sugars during ageing. The mean values of total sugars showed a decrease from 1.48 per cent (0 month) to 1.30 per cent (6 months) during ageing. This decrease in total sugars may be due to micro fermentation during storage. Flory et al*.* [18] also noticed decrease in total sugars, while studying influence of maturation on the nutrient retention and sensory evaluation of fermented beverages developed from blood fruit and aonla. At ‘0’ month, the highest titratable acidity recorded in treatment T_9 (1.72 %) was found to be superior over all other treatments. Lowest titratable acidity was recorded by treatment T_1 (0.60 %). The blended wine's titratable acidity at ‘6’ months storage exhibited a similar pattern to the ‘0’ month of storage. The significantly highest titratable acidity was recorded by treatment T_9 (1.93 %) which was found to be superior over all other treatments. The treatment T_1 (0.77 %) recorded the lowest titratable acidity. During the storage period process, the mean values of titratable acidity increased from 1.16 percent (0 month) to 1.33 percent (6 months). Post-fermentation, certain microbes can metabolize various compounds in wine and turn it into acids. This leads to increase acidity in wine during aging. Increase in titratable acidity of wine during aging period of six months was reported by Akinwale [3] while working on cashew apple wine and Flory et al*.* [18] while working on blood fruit and aonla based fermented beverages. In case of pH, lowest pH was recorded by treatment T_9 (2.12) which found to be remarkably superior over all others treatments. Highest pH was recorded by treatment T_1 (3.36). During six months of storage pH of blended wine showed the same trend as that of initial stage of storage (0 month). Lowest pH was recorded by treatment T_9 (2.04) which was found to be significantly superior over all others treatments. Highest pH was recorded by treatment T_1 (3.22). The mean values of pH showed decrease from 2.67 (0 month) to 2.58 (6 months) during storage. Decrease in pH of wine during storage could be due to production of acids during fermentation. Decrease in pH of wine during storage was reported by Akinwale [3] in cashew apple wine and Reddy et al*.* [19] in aonla based fermented beverages.

At ‘0’ month, the treatment T_9 (338 mg/100 ml) recorded highest ascorbic content which was significantly superior than all others treatments. Lowest ascorbic acid content was recorded by treatment T_1 (150 mg/100 ml). Ascorbic acid content in blended wine at 6 months storage indicated the same pattern as at the starting of storage (0 month). Highest ascorbic acid content was recorded by treatment T_9 (312 mg/100 ml) which was remarkably superior over all others treatments. Lowest ascorbic acid content was recorded by treatment T_1 (142 mg/100 ml). The average ascorbic acid concentration in wine decreased from 262.22 mg/100 ml (0 month) to 237.77 mg/100 ml (6 months) after six months of storage. The decrease in ascorbic acid content in wine during storage may be due to breakdown of ascorbic acid by heat or by the oxidation during storage. Decrease in ascorbic acid content in wine during storage was reported by Gnoumou et al. [20] while studying the stability during aging of mixed cashew and papaya wine produced with palm wine sediment. At ‘0’ month lowest tannin content recorded by treatment T_1 (0.73 %) was significantly superior over others treatments. Highest tannin content in wine was recorded by treatment T_9 (1.94 %). During six months of storage tannin content of blended wine showed the same condition as that of initial stage of storage (0 month). Lowest tannin content recorded by treatment T_1 (0.60 %) was significantly superior over others. Highest tannin content in wine was recorded by treatment T_9 (1.82 %). The mean values of tannin content showed decrease from 1.41 per cent (0 month) to 1.25 per cent (6 months) during storage. Decrease in tannin content of wine during ageing may be due to oxidation. Decrease in tannin content in wine was reported by Suresh et al*.* [21] while studying on aonla based fermented bevarages.

At ‘0’ month, the maximum reducing sugar was recorded by treatment T_9 (0.83 %). Treatment T_5 (0.50 %) showed significantly lowest reducing sugar due to better fermentation and conversion of reducing sugars into alcohol. This can be seen from Table 6, where treatment T_5 (13.87 %) showed higher alcohol content. Prepared wine displayed the same trend of decreasing sugar after six months of storage as it was during the initial period. Lowest reducing sugar was recorded by treatment T_5 (0.42 %) and highest reducing sugar was recorded by treatment T_9 (0.72 %). The reason behind low reducing sugar content in T_5 at the end of storage is already explained above. During the aging process, average values of reducing sugars decreased from 0.63 percent (0 months) to 0.55 percent (6 months). This decrease in reducing sugars during storage may be due to micro fermentation during storage which converts sugars into alcohol. Decrease in reducing sugars of wine during storage was reported by Joshi et al*.* [22] while studying quality of blended wine prepared from white and red varieties of grape (*Vitis vinifera* L.). The alcohol content of wine at '0' month showed that maximum alcohol content was recorded by treatment T_5 (13.76 %). Lowest alcohol content was recorded by treatment T_9 (11.13 %) because it contains highest T.S.S. at the end of fermentation due to improper fermentation. During six months storage alcohol content of blended wine showed the same trend as that of initial stage of storage (0 month). Maximum alcohol content was recorded by treatment T_5 (13.87 %). Lowest alcohol content was recorded by treatment T_9 (11.25 %). The mean values of alcohol content showed increase from 12.58 per cent (0 month) to 12.69 per cent (6 months) during storage. This slightly increase in alcohol content of wine during storage may be due to micro fermentation which leads to conversion sugar into alcohol. Increase in alcohol content of wine during storage were reported by Flory et al. [18] while studying the influence of maturation on the nutrient retention and sensory evaluation of fermented beverages developed from blood fruit and aonla.

Table 1. Chemical composition of cashew apple and aonla natural juice

Sr. No.	Parameters	Cashew apple juice	Aonla juice
1	T.S.S. (° Brix)	12.8	10.4
2	Reducing sugars (%)	7.43	5.27
3	Total sugars (%)	10.34	7.05
4	Titratable acidity (%)	0.35	2.35
5	pH	3.70	2.60
6	Ascorbic acid (mg/ 100 ml)	225	455
7	Tannin (%)	1.75	2.33

Table 2. Chemical composition of must prepared by blending cashew apple and aonla natural juice

Treatments			T.S.S (º Brix)	Titratable acidity (%)	pH
	CA (%)	**A (%)**			
T_1	**100**	**0**	24.13	0.30	3.98
T_2	**90**	**10**	24.00	0.37	3.55
T_3	**80**	**20**	24.00	0.46	3.40
T_4	**70**	**30**	23.93	0.49	3.18
T_5	**60**	**40**	24.00	0.71	3.02
T_6	**50**	**50**	23.86	0.75	2.91
T_7	**40**	**60**	23.93	0.78	2.81
T_8	**30**	**70**	23.93	0.99	2.74
T_9	**20**	**80**	23.93	1.04	2.65
Mean			**23.97**	**0.67**	**3.13**
S. Em (±)			**0.06**	**0.01**	**0.01**
C.D. at 1 %			**NS**	**0.05**	**0.04**

Table 3. Changes in T.S.S.and total sugars of cashew apple and aonla blended wine during storage

Treatments			T.S.S. (ºBrix)		Total sugars (%)	
	Cashew apple juice (%)	**Aonla juice (%)**	**0 month**	**6 months**	**0 month**	**6 months**
T_1	**100**	**0**	8.23	7.43	1.56	1.15
T_2	**90**	**10**	7.23	7.16	1.33	1.02
T_3	**80**	**20**	7.83	7.36	1.41	1.25
T_4	**70**	**30**	6.76	6.30	1.30	1.05
T_5	**60**	**40**	6.28	5.93	1.16	0.96
T_6	**50**	**50**	6.96	6.36	1.52	1.36
T_7	**40**	**60**	7.36	7.09	1.62	1.58
T_8	**30**	**70**	9.08	8.24	1.65	1.63
T_9	**20**	**80**	10.63	9.23	1.82	1.77
Mean			**7.81**	**7.23**	**1.48**	**1.30**
S. Em. (±)			**0.09**	**0.12**	**0.02**	**0.01**
C.D. at 1%			**0.41**	**0.52**	**0.10**	**0.06**

Table 4. Changes in Titratable acidity and pH of cashew apple and aonla blended wine during storage

	Treatments		Titratable acidity (%)		pH	
	Cashew apple juice (%)	Aonla juice (%)	0 month	6 months	0 month	6 months
T_1	100	0	0.60	0.77	3.36	3.22
T_2	90	10	0.81	0.96	3.13	3.04
T_3	80	20	0.90	1.13	2.90	2.83
T_4	70	30	1.05	1.21	2.76	2.63
T_5	60	40	1.15	1.30	2.62	2.51
T_6	50	50	1.26	1.43	2.50	2.41
T_7	40	60	1.44	1.54	2.40	2.33
T_8	30	70	1.56	1.72	2.31	2.26
T_9	20	80	1.72	1.93	2.12	2.04
Mean			1.16	1.33	2.67	2.58
S. Em. (±)			0.007	0.019	0.008	0.009
C.D. at 1%			0.03	0.08	0.03	0.03

Table 5. Changes in ascorbic acid and tannin content of cashew apple and aonla blended wine during storage

Treatments			Ascorbic acid (mg / 100 ml)		Tannin (%)	
	C A (%)	A (%)	0 month	6 months	0 month	6 months
T_1	100	0	150	142	0.73	0.60
T_2	90	10	208	172	0.92	0.82
T_3	80	20	226	214	1.17	1.05
T_4	70	30	252	234	1.37	1.17
T_5	60	40	272	246	1.47	1.27
T_6	50	50	292	256	1.62	1.40
T_7	40	60	304	272	1.65	1.52
T_8	30	70	318	292	1.83	1.67
T_9	20	80	338	312	1.94	1.82
Mean			262.22	237.77	1.41	1.25
S. Em. (±)			2.30	2.40	0.02	0.01
C.D. at 1%			9.53	9.92	0.12	0.05

Table 6. Changes in reducing sugars and alcohol content of cashew apple and aonla blended wine during storage

	Treatments		Reducing sugars (%)		Alcohol (%)	
	C A (%)	A (%)	0 month	6 months	0 month	6 months
T_1	100	0	0.72	0.60	12.55	12.70
T_2	90	10	0.56	0.50	13.03	13.13
T_3	80	20	0.60	0.55	12.76	12.92
T_4	70	30	0.53	0.45	13.26	13.35
T_5	60	40	0.50	0.42	13.76	13.87
T_6	50	50	0.61	0.52	12.82	12.90
T_7	40	60	0.64	0.54	12.40	12.53
T_8	30	70	0.73	0.66	11.51	11.64
T_9	20	80	0.83	0.72	11.13	11.25
Mean			0.63	0.55	12.58	12.69
S. Em. (±)			0.006	0.009	0.06	0.05
C.D. at 1%			0.02	0.04	0.27	0.24

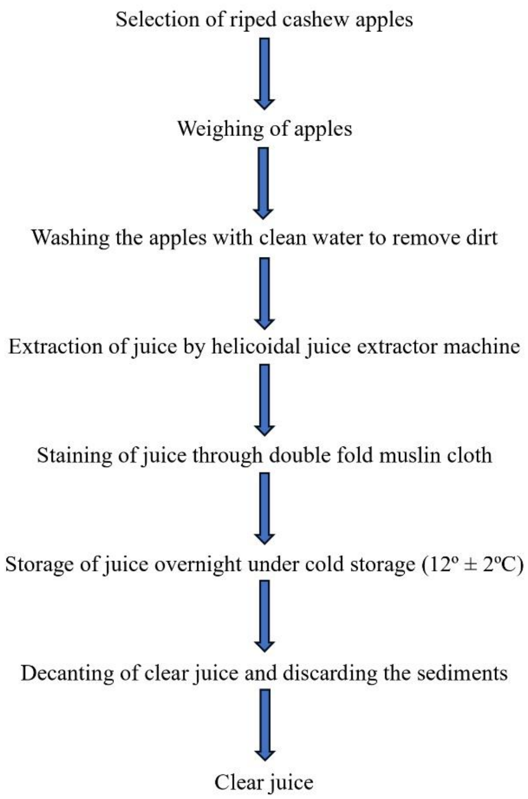

Fig. 1. Extraction of juice from cashew apples

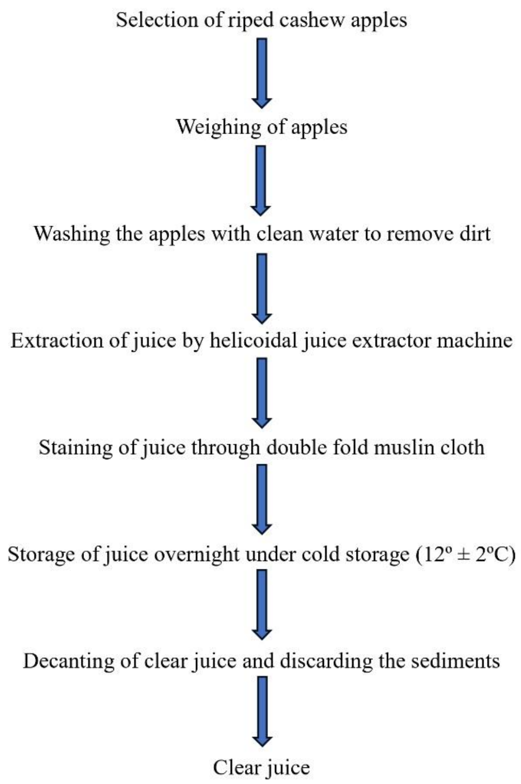

Fig. 2. Extraction of juice from aonla fruits

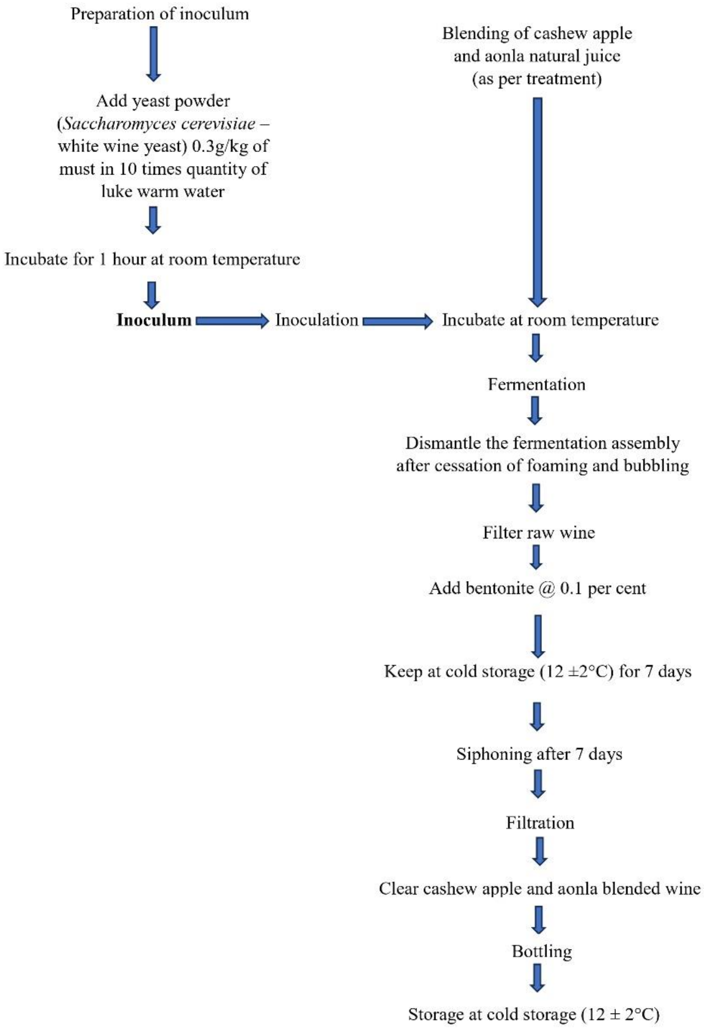

Fig. 3. Preparation of cashew apple-aonla blended wine

4. CONCLUSION

The results of this study indicate that treatment T_5 (60% cashew apple + 40% aonla juice), which has the highest alcohol content (13.89 %). If blended wine prepared from highly acidic aonla and low acidic cashew apples fruits, the prepared wine will be nutritionally rich and helpful for good health of peoples.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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