

Effect of blending cashew apple (*Anacardium occidentale* L.) and aonla (*Emblica officinalis* Gaertn.) juice on quality of wine during storage

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 °Brix 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 T₅ (60 % cashew apple: 40 % aonla juice) had the lowest T.S.S., reducing sugars, total sugars, and alcohol. Treatment T₉ (20 % cashew apple: 80 % aonla juice) had the highest titratable acidity, ascorbic acids content. Lowest pH was recorded by treatment T₉. Treatment T₁ (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 T₅ (60 % cashew apple: 40 % aonla juice) (13.89 %) after aging for six months.

Keywords: Cashew apple juice, aonla juice, blended wine, aging

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 nut and 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 (Chempakam, 1983) and 8000 IU/100 g of vitamin 'A' (Natarajan, 1979). Cashew apple juice is also reported to contain five times more vitamin 'C' as in citrus juice (Akinwale, 2000). 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 (Maciele *et al.*, 1986; Nanjunadaswamy *et al.*, 1985; Ogunsina and Lucas, 2008). The alcoholic drink "feni" made in Indian state of Goa using discarded cashew apples. (Rameshbabu *et al.* 2023).

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 (Singh and Gaur, 2002). A number of various products such as pickle, murabba, juice, candy, squash, jam, jelly, etc., are prepared from aonla (Tripathi *et al.*, 1988). 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.

Material and methods:

The research entitled “Studies on cashew apple (*Anacardium occidentale* L.) and aonla (*Emblia officinalis* Gaertn.) blended wine” was set out in Completely Randomized Design with nine treatments viz. T₁ - (100% cashew apple juice), T₂ - (90% cashew apple juice + 10% aonla juice), T₃ - (80% cashew apple juice + 20% aonla juice), T₄ - (70% cashew apple juice + 30% aonla juice), T₅ - (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 (1997). 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. (1995).

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 °Brix and 10.4°Brix, 7.43 and 5.27 percent, 10.34 and 7.05 percent, 3.70 and 2.60, 0.35 and 2.35 percent, 225 and 455 mg/100 ml

and 1.75 and 2.33 percent, respectively. Similar findings in chemical composition of cashew apple have been recorded by Damasceno *et al.* (2008) and Anand *et al.* (2015). In case of aonla, similar results have been shown by Kulkarni *et al.* (2017) and Singh *et al.* (2016). The T.S.S. of must of all the treatments were adjusted to 24 °Brix. The titratable acidity of must was found to have increased from T₁ (0.30 %) to T₉ (1.04 %) may be due to an increase in aonla juice percentage from T₁ (0 %) to T₉ (80%). Similar results have been recorded by Sadgir (2015) while working on cashew apple and pineapple blended wine. The pH of must decreased from T₁ (3.98) to T₉ (2.65) due to increase in acidity from T₁ (0.30 %) to T₉ (1.04 %). As acids are inversely proportional to pH. Nevasse (2021) 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 T₅ (6.28⁰Brix) due to better fermentation and it was at par with T₄ (6.76⁰Brix) at '0' month storage. Lowest T.S.S. is recorded by treatment T₅ may due to better fermentation of must. The maximum T.S.S. was recorded by treatment T₉ (10.63⁰Brix). 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 T₅ (5.93⁰Brix) due to better fermentation and it was at par with T₄ (6.30⁰Brix) and T₆ (6.36⁰Brix). The T.S.S. mean values dropped from 7.81⁰Brix at 0 month to 7.23⁰Brix 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 (1999) in cashew apple wine and Flory *et al.* (2022) in blood fruit and aonla fermented beverages.

At '0' month lowest total sugar content was recorded by treatment T₅ (1.16 %) which was significantly superior over other treatments. The maximum total sugar content was recorded by treatment T₉ (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 T₅ (0.96 %) which was significantly superior over other treatments and at par with T₄ (1.05 %). The maximum total sugar was recorded by treatment T₉ (1.77 %) which having high T.S.S. content (9.23⁰Brix) at the end of 6 months storage. The data regarding chemical composition of aged wine (6 months storage) showed slightly decrease in 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.* (2022) 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 T₉ (1.72 %) was found to be superior over all other treatments. Lowest titratable acidity was recorded by treatment T₁ (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 T₉ (1.93 %) which was found to be superior over all other treatments. The treatment T₁ (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 (1999) while working on cashew apple wine and Flory *et al.* (2022) while working on blood fruit and aonla based fermented beverages. In case of pH, lowest pH was recorded by treatment T₉ (2.12) which found to be remarkably superior over all others treatments. Highest pH was recorded by treatment T₁ (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 T₉ (2.04) which was found to be significantly

superior over all others treatments. Highest pH was recorded by treatment T₁ (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 (2000) in cashew apple wine and Reddy *et al.* (2017) in aonla based fermented beverages.

At '0' month, the treatment T₉ (338 mg/100 ml) recorded highest ascorbic content which was significantly superior than all others treatments. Lowest ascorbic acid content was recorded by treatment T₁ (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 T₉ (312 mg/100 ml) which was remarkably superior over all others treatments. Lowest ascorbic acid content was recorded by treatment T₁ (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 Gnomouet *et al.* (2022) 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 T₁ (0.73 %) was significantly superior over others treatments. Highest tannin content in wine was recorded by treatment T₉ (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 T₁ (0.60 %) was significantly superior over others. Highest tannin content in wine was recorded by treatment T₉ (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.* (2014) while studying on aonla based fermented beverages.

At '0' month, the maximum reducing sugar was recorded by treatment T₉ (0.83%). Treatment T₅ (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 T₅ (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 T₅ (0.42 %) and highest reducing sugar was recorded by treatment T₉ (0.72%). The reason behind low reducing sugar content in T₅ 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.* (2015) 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 T₅ (13.76 %). Lowest alcohol content was recorded by treatment T₉ (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 T₅ (13.87 %). Lowest alcohol content was recorded by treatment T₉ (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.* (2022) 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 (° Brix)	Titratable acidity (%)	pH
	CA (%)	A (%)			
T₁	100	0	24.13	0.30	3.98
T₂	90	10	24.00	0.37	3.55
T₃	80	20	24.00	0.46	3.40
T₄	70	30	23.93	0.49	3.18
T₅	60	40	24.00	0.71	3.02
T₆	50	50	23.86	0.75	2.91
T₇	40	60	23.93	0.78	2.81
T₈	30	70	23.93	0.99	2.74
T₉	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. (°Brix)		Total sugars (%)	
	Cashew apple juice (%)	Aonla juice (%)	0 month	6 months	0 month	6 months
T₁	100	0	8.23	7.43	1.56	1.15
T₂	90	10	7.23	7.16	1.33	1.02
T₃	80	20	7.83	7.36	1.41	1.25
T₄	70	30	6.76	6.30	1.30	1.05
T₅	60	40	6.28	5.93	1.16	0.96
T₆	50	50	6.96	6.36	1.52	1.36
T₇	40	60	7.36	7.09	1.62	1.58
T₈	30	70	9.08	8.24	1.65	1.63
T₉	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
T₁	100	0	0.60	0.77	3.36	3.22
T₂	90	10	0.81	0.96	3.13	3.04
T₃	80	20	0.90	1.13	2.90	2.83
T₄	70	30	1.05	1.21	2.76	2.63
T₅	60	40	1.15	1.30	2.62	2.51
T₆	50	50	1.26	1.43	2.50	2.41
T₇	40	60	1.44	1.54	2.40	2.33
T₈	30	70	1.56	1.72	2.31	2.26
T₉	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

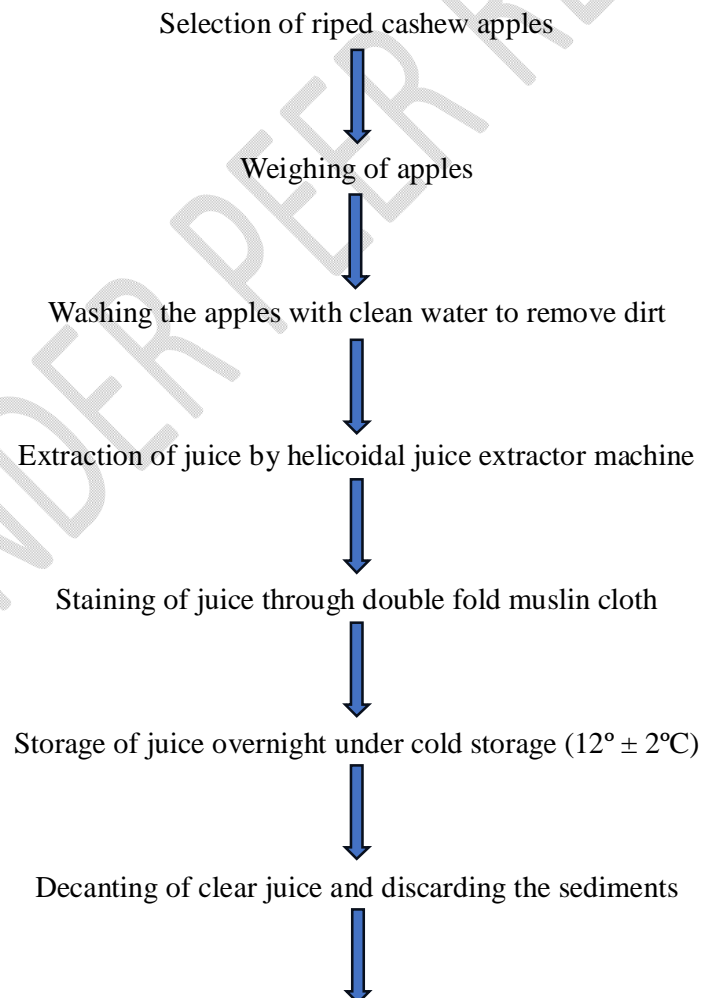
Table 5: Changes in ascorbic acid and tannin content of cashew apple and aonla blended wine during storage

Treatments			Ascorbic acid (mg / 100 ml)		Tannin (%)	
	C A (%)	A (%)	0 month	6 months	0 month	6 months
T₁	100	0	150	142	0.73	0.60
T₂	90	10	208	172	0.92	0.82
T₃	80	20	226	214	1.17	1.05
T₄	70	30	252	234	1.37	1.17
T₅	60	40	272	246	1.47	1.27
T₆	50	50	292	256	1.62	1.40
T₇	40	60	304	272	1.65	1.52
T₈	30	70	318	292	1.83	1.67
T₉	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
T₁	100	0	0.72	0.60	12.55	12.70
T₂	90	10	0.56	0.50	13.03	13.13
T₃	80	20	0.60	0.55	12.76	12.92
T₄	70	30	0.53	0.45	13.26	13.35
T₅	60	40	0.50	0.42	13.76	13.87
T₆	50	50	0.61	0.52	12.82	12.90
T₇	40	60	0.64	0.54	12.40	12.53
T₈	30	70	0.73	0.66	11.51	11.64
T₉	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



Clear juice

Fig. 2: Extraction of juice from aonla fruits

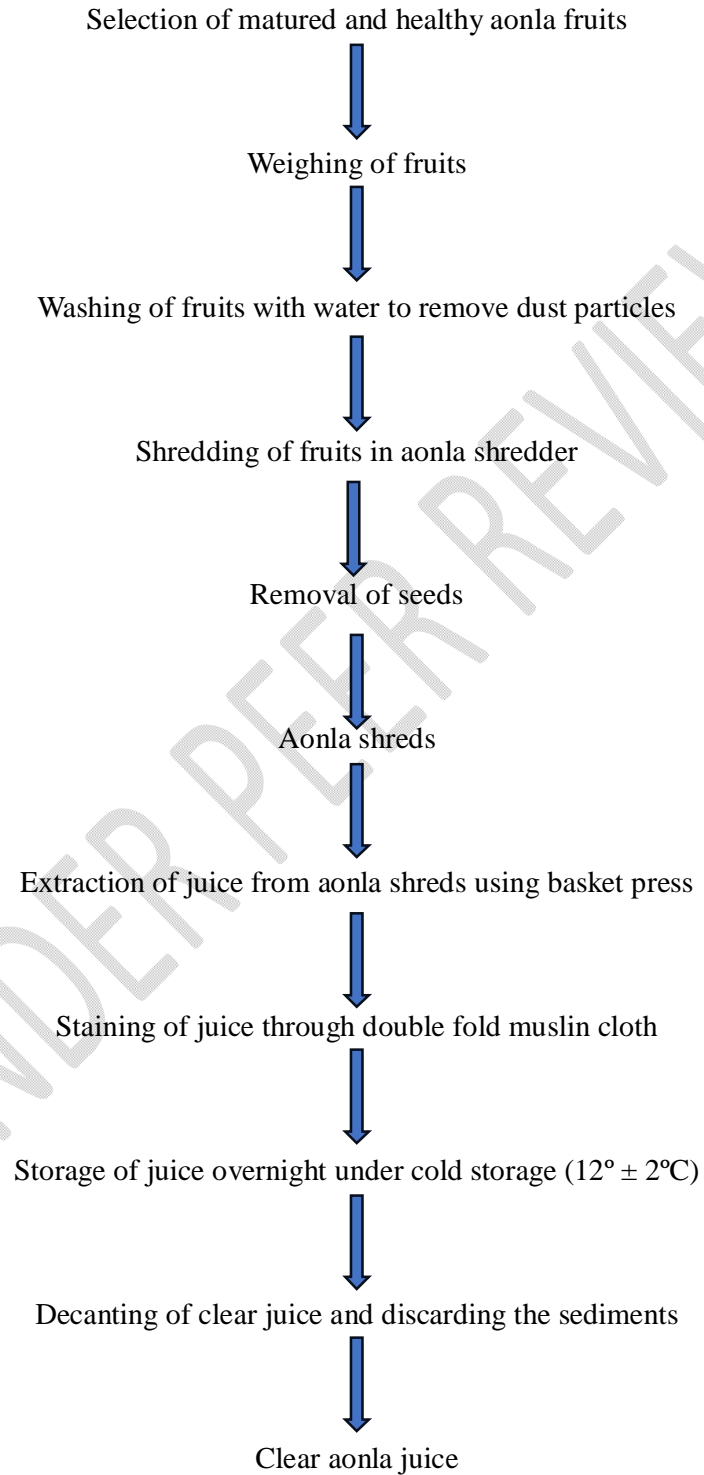
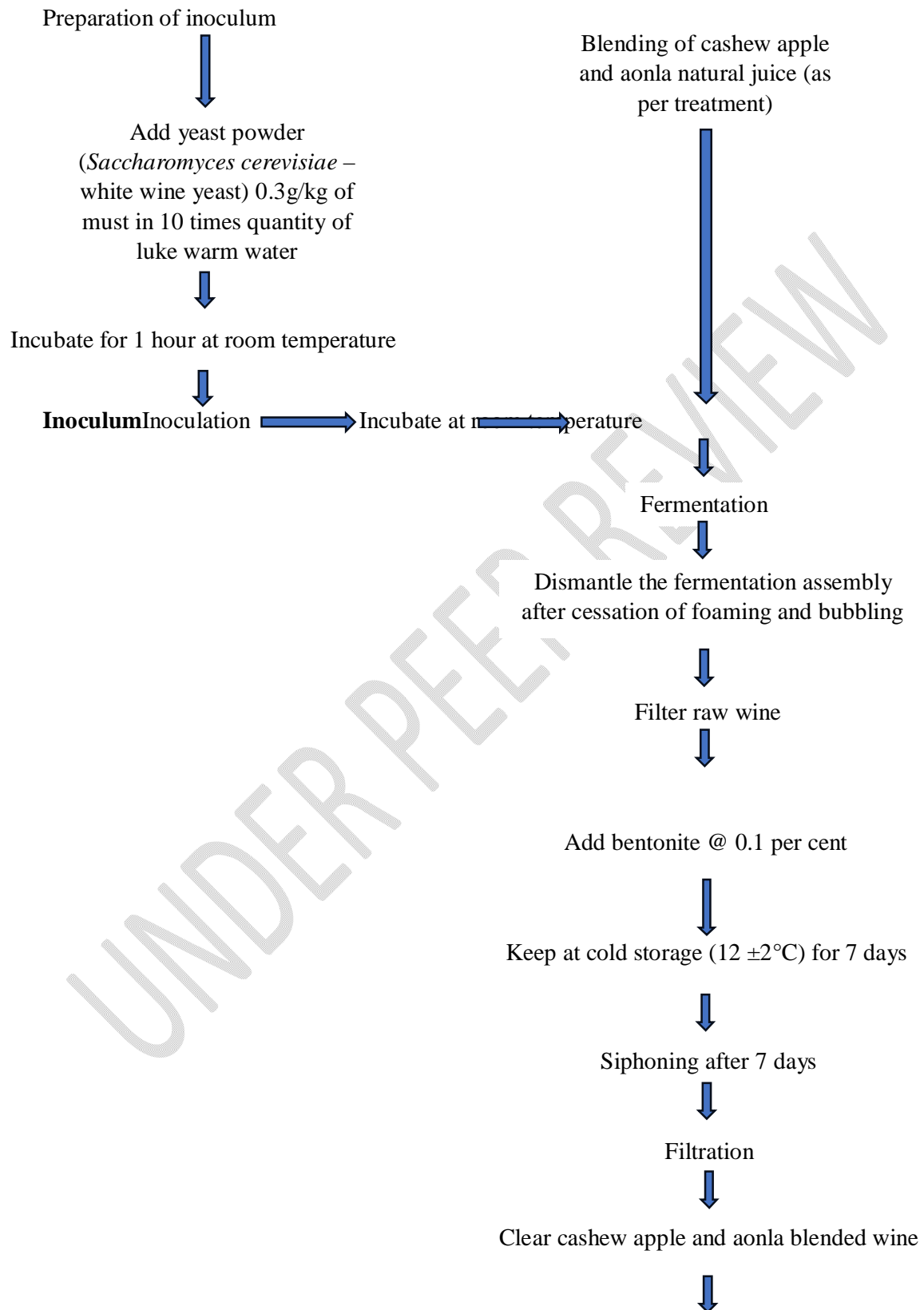


Fig.3: Preparation of cashew apple -aonla blended wine



Bottling



Storage at cold storage ($12 \pm 2^{\circ}\text{C}$)

Conclusion:

The results of this study indicate that treatment T₅ (60% cashew apple + 40% aonla juice), which has the highest alcohol content (13.89 %). 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.

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.

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