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Synergistics of Bioactive Compounds in Underutilized Fruit Syzygium Aqueum Using GC-MS and Sensorial Profile of Value - Added Fruit Preserves

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KEYWORDS

Bioactive compounds, GC-MS, Organoleptic evaluation, *Syzygium aqueum*, Value added products

ABSTRACT:

Introduction: Countless research has been executed universally on various underutilized fruits. *Syzygium aqueum*, (watery rose apple) a plant of the Myrtaceae family with enormous therapeutic properties, has the potentiality to treat an extensive array of illnesses.

Objectives: In the current study, Gas Chromatography-Mass Spectrometry (GC-MS) analysis was employed to identify the bioactive components in methanol extracts of *Syzygium aqueum* fruit. As the fruit is enduring underutilized, an urgent need to focus on the assortment and promotion of underutilized fruits are necessary through the development of value-added products.

Methods: The GC–MS analysis of the fruits of *Syzygium aqueum* was carried out using a GC–MS version (QP 2010 Plus, Shimadzu). Five types of value-added products specifically summer drink (SASD), murabba (SAM), wine (SAW), fruit spread (SAFS) and pickle (SAP) were formulated and standardized

Results: Organoleptic evaluation was administered on all the developed products and the results indicate that SASD was highly acceptable (4.86 ± 0.34) among all other watery rose apple products followed by SAM (4.76 ± 0.43), SAFS (4.76 ± 0.43), SAW (4.73 ± 0.44), and SAP (4.60 ± 0.47). 28 compounds in fruit were discovered during GC-MS study, with 4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6 methyl (6.03%), 2,2'-Bioxirane (5.42%), cis-Calamenene (5.25%), including n-Hexadecanoic acid (3.30%) being the primary constituents. However, the compound with the highest percentage (6.03%) of peak area was 4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6 methyl.

Conclusions: The majority of bioactive substances were documented to have an array of activities, comprising antioxidant, anti-inflammatory, anti-allergic, anti-cancer as well as anti-hyperglycemic properties. The findings of this study offer clear knowledge regarding the diagnostic aid of the fruit and shows significant phytopharmaceutical value. Besides from helping to promote numerous health advantages, value addition to *Syzygium aqueum* fruits will increase utilization by various communities and reduce post-harvest losses.

1. Introduction

The tropical nations, like India, are fortunate with an abundance of naturally grown fruits and vegetables. Numerous fruits possess high nutritional and medicinal value and are underutilized and highly nutritious with reference to vitamin C, antioxidants and carotenoids. Despite this, they are inexpensive and widely available throughout the nation. Fruit plants that are underutilized are also generally disease resistant in nature. The fruits are extremely perishable and challenging to keep fresh [1].

The underutilized fruit watery rose apple (*Syzygium aqueum*), included in Myrtaceae family, is endemic to Southeast Asia and has its inception in Malaysia as well as in India. It is seen over several regions of northern and southern parts India. In traditional medicine, numerous

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portions of the plants like leaves, fruits, seeds along with bark has been exerted for curative purpose [2]. The vernacular names of *Syzygium aqueum* comprises water apple, java apple, rose apple, wax apple, bell fruit and love apple. Whereas in Thai it is chomphu, in Taiwan as bellfruit, in Indonesia as jambu air, in Malay as jambu air, in Philippines as tambis, in Malayalam as chambekka and in Sri Lanka as jumbo. Globally numerous varieties of *Syzygium aqueum* are seen.

The fruits are harvested during the month of January as well as May. The fruit possess modest size, watery, shaped like bell or pear with shinny coating, mushy, with moderate aroma and taste like sweet and sour. The fruit possess two to six seeds. Two varieties of fruits are present in nature. One has white fruits, the other has red or light rose-colored fruits. The ripe *Syzygium aqueum* fruit is mostly eat up fresh because of its high water content, which has the effect of quenching thirst. Fruit pulp is crispy and watery [3].

The most effective approach for determining the bioactive components of hydrocarbons, alcohols, acidic substances, ester derivatives, alkaloid molecules, steroids, amino substances and nitro groups is the major benefit of gas chromatography-mass spectrometry. In addition, towards other conjugated methods reported. Gas Chromatography-Mass Spectrometry (GC-MS) imparts a precise as well as repeatable scientific methodology for authentication, quantification, and identification of bioactive components from plant extracts. The most popular methodology for identification and quantification is Gas Chromatography Mass Spectroscopy, a conjuncture technique that is both an extremely adaptable method and a method that is employed frequently. It is possible to identify any unidentified chemical components from an intricate combination by assessing the spectra and comparing them to reference spectra [4].

The shelf life of the fresh fruit is only 3 days and during the fruiting season a large quantity of water apple fruit is being wasted due to inadequate facilities of storage. The only remedy to such waste is to add value to the fruits concerning to increase the keeping quality of the fruits in the form of products. According to Neeraj *et al*. [5] there is a large potential for food processing together with the value addition of underutilized fruits into several product varieties including squash, jam, candy, dried products, jelly, preserve, pickle and so on. Consumers are always looking for new delicious, nutritious, and appealing food products. To meet this demand, there is a continuous effort to develop products from various sources.

2. Objectives

The primary objective of the present research work is to investigate the bioactive phytoconstituents obtainable in methanol extract of fruit of *Syzygium aqueum* by means of GC–MS method and secondary objective is to formulate value added products using *Syzygium aqueum* fruit and to conduct the organoleptic evaluation of the same.

3. Methods

Procurement and authentication of sample – *Syzygium aqueum*

The fruit of *Syzygium aqueum* was procured from trees growing in home gardens in Kuthanur Village, Palakkad district of Kerala, India. The fruit was harvested in the month of January 2023. The exact site of sample collection was from 8th ward (latitude and longitude of 10°42'54.1"N 76°32'12.5"E). Plant authentication was the prime step involved in the first phase of the study. The fruits and small branch of the tree with leaves was submitted to the herbarium for authentication. The samples were authenticated by scientist in Botanical Survey of India, Ministry of Environment Forest and Climate change, Southern Circle, Coimbatore, India with No. BSI/SRC/5/23/2020/Tech/86. The specimen was deposited in their Institution Herbarium.

Preparation of extract

The fruit samples have been harvested in the morning at 7am and quickly transferred to the laboratory. Just after the onset at the laboratory, fruits were cleansed thoroughly in running water for 4 times to draw out the debris. The extract of the fruit was taken by crushing the fresh fruit with the help of a mortar and pestle. The fruit samples were extracted using methanol by consecutively adding 250 ml methanol with soxhlet extractor for 32 h at a degree never crossing the solvent's boiling temperature for extraction. The extract for analysis was strained with Whatman No. 1 filter paper and further condensed with rotary evaporator in vacuum at 40°C and this was used for further study.

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Gas Chromatography-Mass Spectroscopy analysis

The GC–MS analysis of the fruits of *Syzygium aqueum* was carried out using a GC–MS version (QP 2010 Plus, Shimadzu). The equipment had a length of 30m, 0.25mm diameter, 0.25m dense Rxi-5Sil MS-fused silica capillary pole, a column oven having an ambient temperature that varied in distinct to 80°C to 280°C, whereas the degree of injector is 260°C. Having a column flow value of 1 ml/minute, the carrier gas (Helium, which has 99.99% pureness), was kept at correct position. At a rate of 1,000 scans per 0.50 seconds, the mass fluctuates between 50 and 500 m/z have been examined. 1µl of the fruit's extract was systematically injected directly using the Hamilton's syringe for evaluation. The GC analysis ran for 40 minutes. Peak area standardization was employed to express the number of components available in the extract in the form of percentage. The relative retention time of bioactive substances and their identities has been examined and verified by matching up its mass spectra towards the NIST (National Institute of Standard and Technology) Library's repository of mass spectra. Only peaks which had a match factor with the NIST collection of 70% or above were selected and identified.

Development of value added products

The selected fruits were washed and cleaned thoroughly with running tap water in order to prepare the value added food products. Other ingredients were obtained from the local market for formulating and standardizing the value added products. Five different types of food products such as *Syzygium aqueum* Summer Drink (SASD), *Syzygium aqueum* Murabba (SAM), *Syzygium aqueum* Wine (SAW), *Syzygium aqueum* Fruit Spread (SAFS) and *Syzygium aqueum* Pickle (SAP) were formulated with standard procedures and represented in Figure 1. One standard sample and three test samples were prepared for all the food products. Sugar was used in preparation of standard sample and for test samples, coconut palm sugar is used in different proportions. SASD was standardized using sugar and test samples were prepared in different variations. SASD1 was formulated with 75% sugar and 25% coconut palm sugar, SASD2 with 50% sugar and 50 % coconut palm sugar and SASD3 with 25% sugar and 75% coconut palm sugar. SAM was standardized and prepared in three variations. SAM1 was formulated with 75% sugar and 25% coconut palm sugar, SAM2 with 50% sugar and 50 % coconut palm sugar and SAM3 with 25% sugar and 75% coconut palm sugar. SAW was formulated in ceramic jar in three different variations. SAW1 was formulated with 75% sugar and 25% coconut palm sugar, SAW2 with 50% sugar and 50 % coconut palm sugar and SAW3 with 25% sugar and 75% coconut palm sugar. SAFS was formulated and prepared in three variations. SAFS1 was formulated with 75% sugar and 25% coconut palm sugar, SAFS2 with 50% sugar and 50 % coconut palm sugar and SAFS3 with 25% sugar and 75% coconut palm sugar. SAP was standardized using chili powder and spices. SAP1 was formulated with 75% chili powder and 25% pepper powder, SAP2 with 50% chili powder and 50 % pepper powder and SAP3 with 25% chili powder and 75% pepper powder.

Organoleptic evaluation of value added Products

The developed watery rose apple based value-added food products both standard and test samples were organoleptically evaluated by a council of 30 semi coached evaluator with the help of a 5-point hedonic rating scale (5 = Highly acceptable, 4 = Acceptable, 3 = Moderately acceptable, 2 = Slightly acceptable, 1 = not acceptable). A glass of water was given to each evaluator, and they were told to sip it in between each sample. The semi coached evaluators were asked to evaluate the score of food products for all the organoleptic attributes like colour, flavour, texture, taste, appearance and its overall acceptability. With the aid of several statistical methods, including mean and standard deviation, the acquired data was analyzed.

4. Results

Gas Chromatography-Mass Spectroscopy analysis

The GC-MS chromatogram results display the existence of 28 varieties of bioactive components in the methanol extract of *Syzygium aqueum* fruit (Figure 2). These compounds may be attributed for the medicinal property of the plant. By matching mass spectra using NIST and Wiley Libraries, the results obtained in the present study were interpreted. The determined compounds and its molecular formula, retention time, molecular weight and percentage peak area is presented in Table 1. The compound that possess lowest retention time *i.e.* 4.83 was found to be Acetamide 2-amino and the one which has highest retention time *i.e.* 29.17 was trans-13-

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Table 1. Bioactive compounds in methanol extract of *Syzygium aqueum* fruit

Name of the compound	**Retention Time**	**Molecular formula**	**Molecular Weight**	**Peak %**
Acetamide 2-amino	4.832	$C_2H_6N_2O_2$	74.08	0.2
2,2'-Bioxirane	5.268	$C_4H_6O_2$	86.08	5.42
3-Furanmethanol	6.201	$C_5H_6O_2$	98.1	0.31
Propanoic acid, 2-oxo-, methyl ester	6.535	$C_4H_6O_3$	102.09	1.78
1-Methylpyrazol-4-amine	7.147	$C_4H_7N_3$	97.12	0.12
Cyclopentane	7.231	C_5H_{10}	70.13	0.10
2-Cyclopenten-1-one, 2-hydroxy-	7.249	$C_5H_6O_2$	98.1	0.54
2,4-Dihydroxy-2,5-dimethyl-3(2H)-furan-3-one	8.242	$C_6H_8O_4$	144.12	1.57
3(2H)-Furanone, 4-hydroxy-5-methyl	9.722	$C_5H_6O_3$	114.1	0.16
Furaneol	10.144	$C_6H_8O_3$	128.13	0.15
3-Furancarboxylic acid, methyl ester	10.657	$C_6H_6O_3$	126.11	0.24
4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6 methyl	12.481	$C_6H_8O_4$	144.12	6.03
2-Chloroethyl benzoate	12.834	$C_9H_9ClO_2$	184.62	0.11
Azulene	13.012	$C_{10}H_8$	128.17	1.62
5-Hydroxymethylfurfural	14.643	$C_6H_6O_3$	126.11	1.81
Thymol	16.284	$C_{10}H_{14}O$	150.22	2.22
Methyleugenol	19.074	$C_{11}H_{14}O_2$	178.23	1.17
Coumarin	19.797	$C_9H_6O_2$	146.14	1.03
Myristicine	21.258	$C_{11}H_{12}O_3$	192.21	1.53
cis-Calamenene	21.305	$C_{15}H_{22}$	202.33	5.25
trans-Calamenene	21.305	$C_{15}H_{22}$	202.33	3.03
Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-	21.791	$C_{12}H_{15}NO_6$	253.25	4.41
Phthalic acid, 4-bromophenyl ethyl ester	22.391	$C_{16}H_{13}BrO_4$	349.17	1.17
Tetradecanoic acid	24.546	$C_{14}H_{28}O_2$	228.37	1.79
Psoralen	24.906	$C_{11}H_6O_3$	186.16	2.01
n-Hexadecanoic acid	27.074	$C_{16}H_{32}O_2$	256.4	3.3
(+)-Bakuchiol, acetate	28.992	$C_{20}H_{26}O_2$	298.41	1.02
trans-13-Octadecenoic acid	29.177	$C_{18}H_{34}O_2$	282.46	2.1

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Table 2. Organoleptic Score of Value added food products

Food Products	Colour	Texture	Flavour	Taste	Overall acceptability
SASD	4.16 ± 0.64	4.53 ± 0.50	4.23 ± 0.43	4.26 ± 0.44	4.43 ± 0.50
SASD1	4.26 ± 0.44	4.43 ± 0.50	4.16 ± 0.37	4.13 ± 0.62	4.16 ± 0.37
SASD2	4.66 ± 0.47	4.76 ± 0.43	4.83 ± 0.37	4.86 ± 0.34	4.86 ± 0.34
SASD3	3.36 ± 0.49	3.23 ± 0.50	3.06 ± 0.37	2.86 ± 0.57	3.53 ± 0.57
SAM	4.36 ± 0.55	4.46 ± 0.50	4.23 ± 0.43	4.26 ± 0.44	4.26 ±0.44
SAM1	4.66 ± 0.47	4.63 ± 0.55	4.63 ± 0.49	4.76 ± 0.43	4.76 ± 0.43
SAM2	4.13 ± 0.50	3.96 ± 0.49	4.13 ± 0.43	4.13 ± 0.62	4.06 ± 0.36
SAM3	3.26 ± 0.52	3.23 ± 0.50	3.16 ± 0.53	2.83 ± 0.59	3.33 ±0.47
SAW	4.06 ± 0.73	4.53 ± 0.50	4.23 ± 0.43	4.13 ± 0.50	4.36 ± 0.49
SAW1	4.23 ± 0.50	4.43 ± 0.50	4.13 ± 0.34	4.16 ± 0.64	4.06 ± 0.36
SAW2	4.63 ± 0.49	4.66 ± 0.54	4.83 ± 0.37	4.83 ± 0.37	4.73 ± 0.44
SAW3	3.23 ± 0.52	3.23 ± 0.50	3.16 ± 0.37	2.83 ± 0.64	3.36 ± 0.55
SAFS	4.06 ± 0.73	4.46 ± 0.50	4.16 ± 0.37	4.13 ±0.50	4.36 ± 0.49
SAFS1	4.23 ± 0.50	4.43 ± 0.50	4.06 ± 0.44	4.13 ±0.62	4.13 ± 0.34
SAFS2	4.53 ± 0.50	4.73 ± 0.44	4.83 ± 0.37	4.83 ±0.37	4.76 ± 0.43
SAFS3	3.16 ±0.53	3.23 ± 0.50	3.16 ± 0.37	2.93 ±0.73	3.43 ± 0.56
SAP	3.86 ± 0.57	4.36 ± 0.61	4.13 ± 0.43	4.13 ± 0.50	4.13 ± 0.34
SAP1	3.06 ± 0.52	3.23 ± 0.50	3.16 ± 0.37	2.83 ± 0.64	3.43 ± 0.56
SAP2	4.06 ± 0.44	4.23 ± 0.43	3.96 ± 0.49	4.13 ± 0.62	4.36 ± 0.49
SAP3	4.56 ± 0.50	4.73 ± 0.43	4.83 ± 0.37	4.03 ± 0.55	4.60 ± 0.47

SASD: *Syzygium aqueum* Summer Drink; SAM: *Syzygium aqueum* Murabba; SAW: *Syzygium aqueum* Wine; SAFS: *Syzygium aqueum* fruit spread; SAP: *Syzygium aqueum* Pickle.

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Figure 1. Formulated Value-added products

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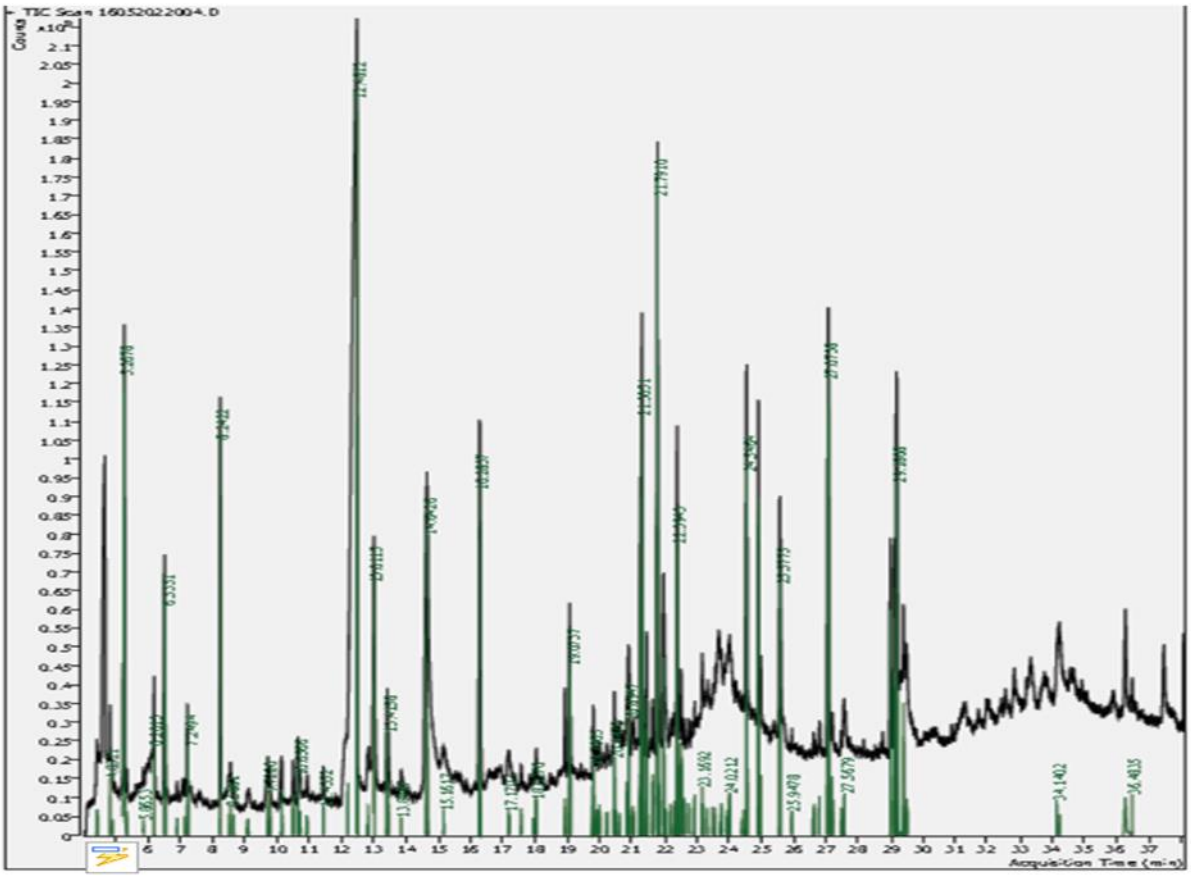

Figure 2. GC-MS chromatogram of methanol extract of *Syzygium aqueum* fruit

octadecenoic acid. The superabundant compound found in the GC-MS evaluation of the methanolic extract of *Syzygium aqueum* fruit was 4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6 (6.03%) (2.22%), trans-13-Octadecenoic acid (2.10%), Psoralen (2.01%), 5-Hydroxymethylfurfural (1.81%), Tetradecanoic acid (1.79%), Propanoic acid, 2-oxo-, followed by 2,2'-Bioxirane (5.42%), cis-Calamenene (5.25%), Benzene, 1,2,3-trimethoxy-5-(2-propenyl)- (4.41%), n-Hexadecanoic acid (3.30%), trans-Calamenene (3.03%), Thymol methyl ester (1.78%), Azulene (1.62%), 3,5-Dihydroxy-2-methylpyran-4-one (1.57%), myristicine (1.53%)., Methyleugenol (1.17%), Phthalic acid, 4-bromophenyl ethyl ester (1.17%), Coumarin (1.03%), (+)-Bakuchiol, acetate (1.02%), 2-Cyclopenten-1-one, 2-hydroxy (0.54%), 3-Furanmethanol (0.31%), 3-Furancarboxylic acid, methyl ester (0.24%), 2-Amino-acetamide (0.20%), 3(2H)-Furanone, 4-hydroxy-5-methyl (0.16%), Furaneol (0.15%), 1-Methylpyrazol-4-amine (0.12%), 2-Chloroethyl benzoate (0.11%), Cyclopentane (0.10%).

Organoleptic evaluation of value added Products

The studies concerning the underutilized and processed fruit products are new, and no such scientific publications and organoleptic evaluation are pinpointed which limits the correlation between the present outcome and those of other researches. Organoleptic evaluation investigates the attributes (texture, appearance, flavour, taste, flavour, etc.) of a commodity or food by using the sensation of panellist (smell, sight, taste, hearing and touch,). For centuries, these kind of investigations were employed to either accept or reject food products. Previously, it was regarded as a technique for evaluating food quality that supplemented technological and microbiological safety [6].

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Each of the data is represented as mean ± SD. The results of organoleptic evaluation (Table 2) indicate that the color of value added products was highly fascinating and the scores ranges from 3.06 ± 0.52 to 4.66 ± 0.47 with SASD2 receiving the highest score and SAP1 receiving the lowest score. The flavour of all of the products tested through organoleptic evaluation showed that highest score of 4.83 ± 0.37 was obtained by SASD2, SAW2, SAFS2 and SAP3, whereas SASD3 received lowest score. Comparable organoleptic scores were achieved for the texture of the products SASD2 (4.76 ± 0.43) receiving the highest score followed by SAW2 (4.66 ± 0.54) and SAM1 (4.63 ± 0.55). The results also represent that taste of all the products were very much liked by the sensory panellists with scores of (4.86 ± 0.34) for SASD2 on a 5-point hedonic scale. The most crucial factor to guarantee consumer acceptance of any product is its overall acceptability. All the products formulated with *Syzygium aqueum* were very well acceptable as indicated by the scores received on a 5-point hedonic scale. As per the sensory score results, summer drink (SASD2) were highly acceptable (4.83 ± 0.37) among all other value added products.

5. Discussion

The GC-MS study revealed that the fruit of *Syzygium aqueum* possesses potential new compounds that might be extracted for therapeutic applications. Selvi and Basker [7] coined that several phytoconstituents found in fruits are perhaps recognized using GC-MS analysis, which provides an accurate clarification of medicinal potentials of the fruit. By examining retention time frames and interpreting their mass spectra, chromatogram of the GC-MS reveals the existence regarding several components in the aqueous extract of *Syzygium aqueum* fruit. The bioactive compound acetamide 2-amino, sometimes referred to as Glycinamide, is a glycine derivative and an amino acid amide possesses antimicrobial characteristics [8]. In the study conducted by Singh *et al*., [9], unsaturated bonds are present in the bioactive molecule 2,2'-Bioxirane, a product of the reaction among vegetable oils. This substance could potentially possess anti-cancer and free radical scavenging properties. However, the literature evaluation indicated that the hydrocarbon and volatile fragrance component 3-Furanmethanol is a potent antioxidant and possesses the aroma of roasted potatoes [10]. Propanoic acid, 2-oxo- methyl ester can be employed and is used as a pesticide, flavoring agent and fungicide.

As identified in the current study, alicyclic hydrocarbon Cyclopentane was also obtained in *Thaumatococcus daniellii* leaf and has also been reported to exhibit antifungal activities [11]. 2-Cyclopenten-1-one, 2-hydroxy exhibits antiviral and antioxidant activity. The 2,4-Dihydroxy-2,5-dimethyl-3(2H)-furan-3-one compound is a supporting component for its activity as a flavoring and antioxidant [12]. Like *Syzygium aqueum*, another antioxidant and volatile compound 4-hydroxy-2,5-dimethyl-3 (2H)- furanone (furaneol) which is linked with the characteristic aroma was also identified in the *V. labrusca* and hybrid types in grape-derived drinks by Kobayashi et al [13]. Furanones are crucial ingredients that contribute to the fragrance of numerous organic commodities and foods that have undergone thermal treatment. Similarly, pro-apoptotic, antiproliferative and antibiotic activities [14] were exhibited by the bioactive component 4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6 methyl that was recognized in the GC-MS analysis. The bioactive compound azulene manifests antiallergic, antibacterial and anti-inflammatory properties. As stated by Pawel *et al.* [15] alternative applications of azulene is used in many different medical fields, such as anti-inflammatory treatment for peptic ulcers, diabetes treatment, antiretroviral treatment for HIV-1, antimicrobial photodynamic therapy, antineoplastic treatment for leukaemia, and antifungal treatment.

Previous reports showed that 5-Hydroxymethylfurfural in the extract disclosed antioxidant, anti-inflammatory and antiproliferative activity [16]. Thymol is a naturally occurring monoterpenoid phenol with numerous practical uses, including those in medicine, dentistry, veterinary medicine, food, and agrochemicals. frequently researched and reported on include its pharmaceutical applications, which concentrate on its strong antibacterial, antioxidant, anti-inflammatory, cicatrizing, [17] antiviral, and antiseptic properties [18]. It was mentioned in HSBD (2010) that Methyleugenol act as a flavouring agent in food industries.

Coumarins are biologically active compounds having a broad array of characteristics and implementations, especially in the fields of therapeutics as well as human

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health. The therapeutic effects of coumarin include antibacterial, anticancer, anti-inflammatory, antiviral, anticonvulsant, anticoagulant, antihypertensive and antihyperglycemic effects. Along with to all these potential applications, they also serve as antioxidants and neuroprotectants [19]. An allylbenzene known as myristicin has been linked to a number of biological properties, which include antidiabetic, anticancer, anti-inflammatory, antibacterial, anti-oxidant, and hepatoprotective. Myristicin is utilized as an ecological treatment for plant protection due to its biological actions in traditional medicine [20]. Similarly, other research studies put forwarded the activities like antioxidant, anti-inflammatory, anti-thrombosis and hypolipidemic in Benzene, 1,2,3-trimethoxy-5-(2-propenyl).

Tetradecanoic acid a long-chain saturated fatty acid is commonly known as myristic acid. According to the report of Mohy *et al.* [21] in the leaf extracts (methanolic) of *C. mediterranea*, *P. capillacea* and *J. rubens* tetradecanoic acid has been found. Tetradecanoic acid, which was also found in *P. capillacea* and *Myristica fragrans* (nutmeg), was the predominant antibacterial and antioxidant principle that was discovered in earlier investigations [22]. In addition, tetradecanoic acid also inhibits cell division and has nematocidal and hypocholesterolemic properties. According to pharmacological studies, psoralen is an organic chemical called furocoumarin that is found in nature and has anticancer [10] antioxidant, and antibacterial properties [23]. Khan *et al.* [24] suggested that the natural exertions includong antimicrobial, anti-androgenic, hemolytic, antioxidant and anti-inflammatory, antidiabetic and hypocholesterolemic effects are exhibited by n-Hexadecanoic acid.

A meroterpene bakuchiol acetate has been identified to possess potent antibacterial properties and anti-aging potential. Anti-acne property was reported by Yvonne *et al*. [25], anticancer and antidiabetic property by Li *et al.* [26]. The dentified compound trans-13-Octadecenoic acid exhibits both anticancer and antibacterial activity. Whereas Belakhdar et al. [27] coined through their research that octadecanoic acid methyl ester has antifungal properties. The biological activity of a few identified bioactive compounds was not reported.

Value addition of *Syzygium aqueum* into different products will improve the health benefits of the individuals on account of various antioxidants and phytochemicals present in it. Color can represent an extremely significant organoleptic component associated with food products and has a dominant function in ascertaining the overall quality of the product. As a significant predictor of nonsensory characteristics of food products including pigment, moisture level and over-processing influences consumer evaluation of other sensory qualities like flavour, sweetness, and saltiness [28]. The scores of organoleptic evaluation indicate that all food products formulated with *Syzygium aqueum* had fascinating color. This is because the color of coconut palm sugar and also the pigment anthocyanin present in the fruit of *Syzygium aqueum.* Phenolic chemicals impart a significant function in the distinctive sensory and organoleptic characteristics of plants, including their color, flavour, and astringency [29].

The score of flavor of all the food products are enhanced due to the occurrence of flavoring components identified in the GC-MS technique. Bioactive compounds such as 3-Furanmethanol, propanoic acid, 2-oxo-, methyl ester, 2,4-Dihydroxy-2,5-dimethyl-3(2H)-furan-3-one, furaneol and methyleugenol are responsible for contributing the flavor of value-added products [17] and [21]. The acidic and sweet taste of the fruit enhances the taste of the developed value-added food products.

Numerous elements, which may be connected to the consumer, the food, or the context in which the meal is consumed, have an impact on how generally acceptable food is. The organoleptic attributes of the food, prior exposure to it and following requirements, specific aspects, culture of the individual, and physiological conditions (which includes satiety, thirst, and the existence or lack of illness), between several other variables, are all influences on the overall acceptance, a hedonic-based subjective measurements. The overall acceptability score of summer drink score more than other value added products because of the enhanced taste, texture, color and flavour.

Several researchers [24] [25] [30] reported various health benefits of *Syzygium aqueum* and only one or two products are available in the market during the season. So value addition increases the utilization of this fruit. Exploitation of this underutilized fruits could assist combat the local population's social issues of poor health, inadequate nutrition, and the rate of unemployment

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Local residents can achieve socioeconomic stability by selling these fruits in its natural state and as value-added commodities. Continuous attainments are necessary to set up manufacturing units, suitable processing techniques, value addition, advertising and trading the products.

6. Conclusion

Syzygium aqueum fruit samples were analyzed using GC-MS. The extract of *Syzygium aqueum*, a valuable source of bioactive chemicals with potential therapeutic value, confirmed the presence of 28 distinguishable phytochemical components, as proven by the current investigation. Investigating the pharmacological and biosynthetic activity in plants may be valuable as a result of the study. It needs in-depth research in order to be used by the pharmaceutical sector for drug development. Isolating specific phytochemical components and subjecting them to biological action will probably produce beneficial results for future research. In light of this, it was determined that the biological properties of *Syzygium aqueum* fruits contain pharmacologically active compounds that may enhance their use as standard medicine. Formulation of value added products using watery rose apple can aid in popularization of the original potentials of the fruit. Value addition pave way to the local farmers to earn greater income by advertising the usage of underutilized fruit. As a consequence, watery rose apple (*Syzygium aqueum*) should be promoted for the large scale development and formulation of varieties of value added products for unwanted wastage of the fruit due to its decreased shelf life and also for income generation.

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