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RESEARCH PAPER

Physico-chemical Properties of Wood Apple

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ABSTRACT

Wood apple (*Limonia acidissima* L.) is belonging to the *Rutaceae* family. Wood apple pulp rich source of Beta carotene, a precursor of vitamin-A. The study was conducted to analysis of physico-chemical properties of wood apple. Proximate composition of wood apple fresh pulp moisture content (79.26 to 79.58 %), protein (8.31 to 8.35 %), fat (1 to 2.010%), ash (0.986 to 1.82 %), total soluble solids (17.60 to 17.80%), total sugar (6.41 to 6.43%), reducing sugar (5.2 to 5.6 %), ascorbic acid (5.12 to 5.121%), acidity (4.5 to 4.7%) respectively.

Keywords: Wood apple, pulp, proximate composition, physico-chemical properties etc.

Wood apple (*limonia acidissima* L.) is belongs to the family *Rutaceae*, is a underutilized fruit plant and traditional herb in India. It is known by different names such as *kavat*, *kainth*, *elephant apple*, and *monkey fruit*. It is native to India, Pakistan, Sri Lanka and Vietnam (Troup, 1921). In India, the fruit ripens from early October throughout the March. States growing the wood apple fruit include Maharashtra, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Madhya Pradesh and the western Himalayas (Pareek and Sharma, 2009).

Wood apple is a small to moderate size, deciduous, glabrous tree with thorny branches reaching to a height of 10 meters with 0.6 meters to 1.6 meters girth (Troup, 1921). Wood apple tree yields 200-250 fruits per year (Pareek and Sharma, 2009). Wood apple are available in western Himalayas, it is more common in the Thane and Chandrapur district of Maharashtra. It is also reported to occur in parts of Hazaribagh, Palamau and Chota Nagpur in Jharkhand (Hiwale, 2015).

The wood apple pulp is a rich source of Beta carotene, a precursor of vitamin-A which also contains significant amount of vitamin and it had small quantities of ascorbic acid content (Vijayakumar *et al.* 2013). The scooped-out pulp is eaten raw with or without sugar, or is blended with coconut milk and palm sugar syrup and frozen as an ice-cream. In Indonesia, wood apple is mixed with honey and eaten for breakfast (Morton, 1987). Wood apple pulp used in India for savory chutneys. Even though all these benefits this is quite neglected fruit in India and supposed to be minor fruit crop but in most of tribal part of central India this fruit is available in ample form and can be processed into chocolate very easily. Fruits have high medicinal value and used in India as a liver and cardiac tonic while unripe fruits are used as an astringent means of treating diarrhea and dysentery in folk medicines. It is effective treatment

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for hiccups, sore throat and diseases of the gums. The fruit are also used for curative properties, which makes it is one of the useful medicinal plants of India. Antimicrobial activity of essential oil extracted from wood apple fruits and noticed its effectiveness against 12 human pathogenic bacteria (Geda *et al.* 1980). The brown pulp is resinous, astringent, aromatic odorous, acid or sweetish with scattered seeds. The fruit might be large and sweet or small and acid (Vijayvargia and Vijayvergia, 2014).

Wood apple fruit are consumed as a good source of juice during its harvesting season due to their low cost and thirst quenching ability. A homemade drink popularly known as "*sarbat*" is prepared from the wood apple fruits. The flesh of the mature fruits blended with cardamom, honey and cumin seeds are efficacious for indigestion, diarrhea and piles.

Wood apple pulp was also used for the preparation of powder. It is the dehydrated product and had very long shelf life without any appreciable change. With the addition of ginger and aonla powder, the nutritive value also increased. The average chemical composition like TSS range from 10.67 to 14.33 °Brix, acidity 1.04-4.50% and total sugar 4.08-4.47% was reported in wood apple (Hiwale, 2006). The nutritional and chemical properties of fresh wood apple fruits showed that it contains 6.3g protein, 15.6g titrable acidity, 2.6mg/100g vitamin-C, 235mg/100g total phenol and 1412.55µg/g total antioxidant capacity (Vijayakumar *et al.* 2013).

Realizing the importance of fruits as a significant contributor to human wellbeing, as a cheaper and better source of protective foods, their perishable nature and seasonality in production calls for preservation of them to be supplied throughout the year for human consumption.

The scooped-out pulp is eaten raw with or without sugar, or is blended with coconut milk and palm sugar syrup and frozen as an ice-cream. In Indonesia, wood apple is mixed with honey and eaten for breakfast (Morton, 1987). Wood apple pulp used in India for savory chutneys. Even though all these benefits this is quite neglected fruit in India and supposed to be minor fruit crop but in most of tribal part of central India this fruit is available in ample form and can be processed into chocolate very easily.

MATERIAL AND METHODS

The study was conducted in the Department of Post-Harvest Engineering Post Graduate Institute of Post-Harvest Management, Killa-Roha, Dr. Balasaheb Sawant Kokan Krishi Vidyapeeth Dapoli, during the year 2017-18.

Procurement of wood apple fruits

The mature wood apple fruit was procured from the local farmer farm Palsawade, Tal. Man, District. Satara. Wood apple pulp was scooped out with seed from hard shell with the help of spoon and separate the pulp and seeds from sieve.

Physico-chemical analysis of wood apple pulp

Moisture content

The Initial moisture content of the wood apple pulp determined by using hot air oven method (AOAC, 2010). The 10 g wood pulp was kept in the moisture boxes. The moisture boxes was kept in hot air oven at 105°C for 24 h. The final weight of wood apple pulp after 24 hrs was recorded. The moisture content of the wood apple pulp were determined by using the following formula:

$$Moisture\ content\ (db) = \frac{W_2 - W_1}{W_3 - W_1} \times 100 \quad \ldots (1)$$

Where,

W_1 = Weight of moisture box, g

W_2 = Weight of moisture box + sample g

W_3 = Weight of moisture box + oven dried sample, g

Protein

Protein in the sample was determined by a Micro-Kjeldahl distillation method (AOAC 1990). The samples were digested by heating with concentrated sulphuric acid (H_2SO_4) in the presence of digestion

mixture, potassium sulphate (K_2SO_4) and copper sulphate ($CuSO_4$). The mixture was made alkaline with 40% NaOH. Ammonium sulphate thus formed. Released ammonia which was collected in 4% boric acid solution and titrated again with standard HCL. The percent nitrogen content of the sample was calculated the formula given below. Total protein was calculated by multiplying the amount of percent nitrogen with appropriate factor (6).

$$\% (N) = 1.4 \times (ml\ HCl - ml\ blank) \times \frac{Conc.\ of\ HCL}{Weight\ of\ sample\ (g)} \quad \ldots (2)$$

$$\% \ Protein = \% \ N \times Factor\ (6.25). \quad \ldots (3)$$

Ash Content

The tare weight of three silica dishes (7-8 cm dia) was noted and 5 g of the sample (wood apple pulp) was weighed into each silica dish. The contents were ignited on a Bunsen burner and the material was ashed at not more than 525°C for 4 to 6 hr. in a muffle furnace. The dishes was cooled and weighed. The difference in weights represented the total ash content and was expressed as percentage. Rangana (1986).

$$Ash\ Content = \frac{\text{Weight of crucible with ash} - \text{Weight of crucible}}{\text{Weight of sample in } (g)} \times 100 \quad \ldots (4)$$

Fat Content

Fat content of wood apple pulp as per the treatments composition was determined by soxhlet fat extraction system (AOAC, 2010) in a soxhlet apparatus (Make: Elico, Hyderabad). In this method, initially weight of empty flask was weighted. 2 g wood apple pulp was taken into it. The sample with filter paper was kept in siphoning tube and condenser was fixed above it and siphoned for 9-12 times with the petroleum ether in soxhlet apparatus. After removing assembly, evaporation of petroleum ether was allowed by heating round bottom flask. Residue remained at the bottom of the flask and was reweighted with flask. The quantity of residue was determined as fat content of wood apple pulp. The experiment was replicated for 3 times. The average value of fat content was reported. The fat content was calculated by using following equation.

$$\% \ Fat\ content = \frac{Final\ wt. - Initial\ wt.}{Wt.\ of\ sample} \times 100 \quad \ldots (5)$$

Total soluble solids

Total soluble solids were estimated at ambient temperature by hand refractometer (Erma, Japan) with a scale ranging from 0° to 32° Brix. The observations were corrected to 20°C and expressed as °Brix (AOAC 2000). The wood apple pulp sample 5g was dissolve in 15 ml of water, the dissolve sample placed on prism plate to record the visible value on scale. The reading of sample as °Brix was obtained and digital reading of the TSS expressed accordingly. Three observation were taken for replication.

Acidity

To a diluted pulp (5g of pulp was diluted with 20 ml of water) three to four drops of 0.5 % phenolphthalein indicator (1 % in 5 % V/W alcohol) was added and mixture was then titrated against 0.1 N NaOH until a stable brownish pink color was developed. The titre value obtained was used in the following formula to find out Titrable acidity in terms of citric acid (Ranganna, 1986).

$$Percent\ acidity = \frac{100 \times Equivalent\ Wt.\ of\ citric\ acid \times titre\ value \times Normality\ of\ NaOH}{1000 \times Weight\ equivalent\ of\ the\ sample} \quad \ldots (6)$$

Reducing sugars

The reducing sugars was estimated by using Lane and Eynon Method (1923) with modifications suggested by Ranganna (1997). A 25g weight of wood apple pulp sample was blended with distilled water using lead acetate (45%) for precipitation of extraneous material and potassium oxalate (22 %) to the lead in the solution. This lead free extract was

used to estimate reducing sugars by titrating against standard Fehling' mixture (Fehling A and B in equal proportion) using methylene blue as an indicator to a brick red end point. The reducing sugar was calculated as below:

$$Reducing\ sugars = \frac{Factor \times Dilution \times 100}{Titre\ reading \times Wt.\ of\ sample} \quad \ldots (7)$$

Ascorbic acid

5 g of wood apple pulp sample was macerated with 15 ml of 3% HPO_3 (metaphasphoric acid) solution. The samples was filtered through muslin cloth in to 50 ml volumetric flask and volume will be made up with 3% HPO_3 solution.

The 5 ml aliquot was taken from volumetric flask and titrated against 2, 6-dichloropheno-lindophenol dye solution (AOAC, 2010). The end point was marked by appearance of light pink colour. The determination procedure was followed as described by (Ranganna, 2010).

Ascorbic acid =

$$\frac{Titre \times Dye\ factor\ \times\ Volume\ made\ up}{Aliquot\ of\ extract\ taken\ for\ estimation\ \times\ Wt.\ or\ volume\ of\ sample\ taken\ for\ estimation} \times 100 \cdots (8)$$

Total sugar

Sugar Fehling's 'A' and 'B' solution (Lane and Eynon, 1923) was used to estimate the sugar content in sample and the procedure as suggested by Ranganna, (2010). Total sugar was calculated and expressed in per cent.

Total sugar =

$$\frac{Factor \times Dilution}{Titre\ reading \times Weightn\ of\ sample} \times 100 \quad \ldots (9)$$

RESULT AND DISCUSSION

Physico-chemical Properties of wood apple pulp

Table 1 shows the physico-chemical properties of wood apple pulp such as total soluble solids (°Brix), total sugar (%), reducing sugar (%), ascorbic acid (%), titrable acidity (%), moisture (%), Protein (%), Fat (%), Ash (%) for wood apple pulp.

Moisture

Table 1 shows moisture content of wood apple pulp without seed. Moisture content of wood apple pulp was in the range 79.26 to 79.58 % and average was 79.438±0.165. The moisture content of wood apple pulp was 77.02%, 94.93%, 73.97%, 77.5% reported by Devi and Kulkarni (2018) and Minn and Oanh (2018), Sonawane and Arya (2013), Gopal *et al*. (2002).

Protein

Table 1 shows the Protein content of wood apple pulp without seed was ranged from 8.31 to 8.35 per cent and average was 8.333±0.021. Sivakkolundu and Loganathan, (2013), Hiwale (2015), Lakshimi *et al.* (2015), Sonawane and Arya (2013), Gopalan *et al*., (2007), Diengngan and Hasan (2015) reported the protein content in wood apple pulp 8%, 7.10%, 9.61%, 10.43% and 7.10% and 7.1%.

Fat

Table 1 shows fat content of wood apple pulp. Fat content of wood apple pulp ranged from 1.003 to 2.010 per cent and average was 1.408±0.532. The fat content of wood apple pulp was 1.54%, 1.38%, reported by Sivakkolundu and Loganathan (2013) and Anitha *et al*. (2016).

Ash

Table 1 shows the ash content of wood apple pulp ranged from 0.986 to 1.842% and average was 1.390±0.430 %. Gopal *et al.* (2007), Anita *et al.* (2016), Patel (2013), Sharma (2014), Gopal *et al.* (2002), Lakshimi *et al.* (2015), Sonawane and Arya (2013) reported the ash content of wood apple pulp as 1.9%, 1.5%, 1.35%, 1.35%, 0.9%, 1.73% and 2.66%.

Total soluble solids (°Brix)

Table 1 shows total soluble solids of wood apple pulp. Total soluble solids of wood apple pulp was in the

range 17.60 to 17.80% and average was 17.667±0.115 the total soluble solids of wood apple pulp reported in literature was 18.52%, 19% by Chowdhury *et al.* (2008) and Sneha and Deb (2018), Yadav (2018) and Sharma (2014).

Total sugar

Table 1 shows total sugar of wood apple pulp. Total sugar of wood apple pulp was in the range 6.41 to 6.43% and average was 6.420 ± 0.010 the total sugar of wood apple pulp reported in literature was 7.05% by Devi and Kulkarni (2018), Kumar and Deen (2017).

Reducing sugar

Table 1 shows reducing sugar of wood apple pulp. Reducing sugar of wood apple pulp was in the range 5.2 to 5.6 % and average was 5.478 ± 0.240. Reducing sugar of wood apple pulp reported in literature was 7.05% by Kumar and Deen (2017).

Ascorbic acid

Table 1 shows Ascorbic acid of wood apple pulp. Ascorbic acid of wood apple pulp was in the range 5.12 to 5.121 per cent and average was 5.084 ± 0.065. The Ascorbic acid of wood apple pulp reported in literature was 5.42% and 5.45% by Devi and Kulkarni (2018), Kumar and Deen (2017).

Table 1: Physico-chemical properties of wood apple

Sl. No.	Parameter	Wood apple fresh pulp	SD
1	Moisture content (%)	79.438	±0.165
2	Protein (%)	8.333	±0.021
3	Fat (%)	1.408	±0.532
4	Ash (%)	1.390	±0.430
5	Total soluble solids (°Brix)	17.667	±0.115
6	Total sugar (%)	6.420	± 0.010
7	Reducing sugar (%)	5.478	±0.240
8	Ascorbic acid (g)	5.084	±0.065
9	Acidity (%)	4.667	±0.153

Acidity

Table 1 shows acidity of wood apple pulp. Acidity of wood apple pulp was in the range 4.5 to 4.7 % and average was 4.667±0.153. The titrable acidity of wood apple pulp reported in literature was 4.10%, Kumar and Deen (2017).

CONCLUSION

Wood apple is useful for human health. Nutritional composition of Wood apple i.e. Moisture content, Protein, Fat, Ash, TSS, Titrable acidity, Reducing sugar, Ascorbic acid and Total sugar. The average moisture contain (79.438±0.165), protein (8.333±0.021), fat (1.408±0.532), ash (1.390±0.430), TSS (17.667±0.115), acidity (4.667±0.153), reducing sugar (5.478±0.240), ascorbic acid (5.084±0.065) and total sugar (6.420±0.010) respectively.

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