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Studies on Arjun (*Terminalia arjuna* Roxb.) for Tannin and Ash Content in Vidarbha Region of Maharashtra, India

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ABSTRACT

Arjuna (*Terminalia arjuna* Roxb.) a renovate tree species for commercial medicinal tree species. It contains various medicinal properties and secondary metabolites. The present study investigated specially for ash content and tannin content. The field experiments were conducted at Malkapur block (MB) and Nagarjune medicinal plant garden (Nag) Akola in College Campus Dr. P. D. K. V. Akola and Amravati in Wan wild life Sanctuary (Wan) Akot. In the laboratory of department of Soil Science Agril Chemistry Dr. P. D. K. V. Akola estimation of the tannin and ash content in the bark of *Terminalia arjuna* was carried out. In bark, maximum tannin content (13.76%) was found in Wan-16 while in leaves tannin content (6.96%) was noticed in Wan-14. The significant variation in height, diameter and canopy spread. The data determined significant variation among the ash content in fruits. The maximum ash content in fruit of 4.82 % was found in Wan-18.

Keywords Arjuna, Tannin, Ash, Content, Variability, Fruit, Leaves, Bark.

INTRODUCTION

The genus name *Terminalia* is derived from the Latin word "Terminus" or "Terminalis" (meaning "ending") and refers to the characteristic arrangement of leaves clustered at the tips of the shoots. Trees belonging to this genus are notable for their production of secondary metabolites, including cyclic triterpenes and their derivatives, flavonoids, tannins, and aromatic compounds (Wadhai 2012).

Terminalia arjuna (Roxb.) Wight and Arn., commonly known as 'Arjuna,' has long been utilized as a cardiotonic for managing conditions such as heart failure, ischemia, cardiomyopathy, atherosclerosis, and myocardial necrosis. It is also used to treat various human ailments, including blood disorders, anemia, venereal and viral diseases, and to promote overall health. Additionally, it has applications in treating fractures, ulcers, and liver-related conditions, and it

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exhibits a range of pharmacological activities such as hypocholesterolemic, antibacterial, antimicrobial, antitumoral, antioxidant, antiallergic, antifeedant, antifertility, and anti-HIV properties (Ram *et al.* 1997, Phani *et al.* 2013).

Terminalia arjuna timber is widely used locally for crafting carts, agricultural implements, traps, boat construction, electric poles, tool handles, and jetty piles. Additionally, when blended with other woods, it yields rayon-grade pulp of satisfactory quality. In India, the tree plays a vital role in rearing tasar silkworms and serves as livestock fodder, with its extensively lopped leaves containing 9-11% crude protein and 14-20% crude fiber. The bark holds 22-24% tannin, while the fruits contain 7-20% and the leaves 10-11%. Tannin extracted from the tree is valuable for tanning and dyeing, producing high-quality upper leather and excellent sole leather with a light-brown or buff color, often exhibiting a reddish tint. Rich in calcium carbonate, the bark is frequently burned to produce lime, commonly used for chewing with betel. Additionally, it aids in clarifying turbid water by facilitating mud precipitation. This species thrives along old irrigation channels, tank bund edges, and seasonal alluvial bars in dry watercourses, where its extensive root system helps control soil erosion along riverbanks. In India, its leaves and flowers hold sacred significance (Orwa *et al.* 2009).

MATERIALS AND METHODS

Plant material: In the investigation, samples were collected out from different locations in Akola viz. Malkapur block (MB), Nagarjun Medicinal Plants Garden (NAG), Dr. P. D. K. V., Akola campus and in Wan Wildlife Sanctuary, Akot (WAN), Maharashtra. Twenty trees which having approximately uniform growth and age were selected and the bark of these trees removed from the stem (trunk) without destroying the tree. The blaze was chosen on four sides (East, West, North and South). The fruits and leaves (5 each) were selected from upper, middle and lower branches of Arjun.

Biochemical analysis

Tannin content: The tannin content was determind as per Folin-Denis method (Thimmaiah 2009). The material required for Folin-Denis method :Folin-Denis Reagent: Dissolve 100 g sodiumtungstate and 20g phosphor molybdic acid in 750 ml distilled water in a suitable flask and add 50 ml phosphoric acid. Reflux the mixture for 2 h and make up to 1 l with water. Protect the reagent from exposure to light. Sodium Carbonate Solution: Dissolve 350 g sodium carbonate in 1 l of water at 70–80C. Filter through glasswool after allowing it to stand overnight. Standard Tannic Acid Solution: Dissolve 100 mg tannic acid in 100 ml of distilled water. Working Standard Solution: Dilute 5 ml of the stock solution to 100 ml with distilled water. One ml of solution would contain 50 mg tannic acid and procedure is as follows:

Extraction of tannin: Weigh 0.5 g of the powdered material and transfer to a 250 ml conical flask. Add 75 ml water. Heat the flask gently and boil for 30 min. Centrifuge at 2,000 rpm for 20 min and collect the supernatant in 100 ml volumetric flask and make up the volume.Transfer 1 ml of the sample extract to a 100-ml volumetric flask containing 75 ml water. Add 5ml of Folin-Denis reagent, 10 ml of sodium carbonate solution and dilute to 100 ml with water. Shake well and read the absorbance at 700 nm after 30 min. Prepare a blank with water instead of the sample. If absorbance is greater than 0.7, make appropriate dilution. Prepare a standard graph by using 0–100 mg tannic acid. The calculation is done with the help of the tannin content of the samples as tannic acid equivalents from the standard graph.

Ash content: The ash content was recorded by following standard procedure given by Ranganna (1994).

$$\text{Ash (\%)} = \frac{\text{Weight of silica dish after ashing -Tear weight}}{\text{Initial weight of sample}} \times 100$$

The data were statistically analyzed by using Randomized Block Design in twenty treatments and three replications as per Panse and Sukhatme (1987) and Chandel (1984). The statistical analysis represents in Table 1 shows significance in variation of tannin and ash content.

Table 1. Analysis of variances for six traits.

Sl. No.	Source of variation	Degree of freedom	Tannin in bark (%)	Tannin in leaves (%)	Tannin in fruits (%)	Ash in bark (%)	Ash in leaves (%)	Ash in fruits (%)
1	Replications	2	2.649	0.621	4.883	3.467	1.395	1.339
2	Treatments	19	13.101**	1.201*	2.573**	11.617*	5.282**	3.354**
3	Error	38	0.860	0.640	0.817	24.720	0.235	0.265

RESULTS AND DISCUSSION

The results obtained in present investigation revealed significant results focusing on important morphological and biochemical characterization of *Terminalia arjuna* and are discussed under following heads

The results for morphological traits viz., height, DBH, and canopy spread were found to be statistically significant. The data related to these parameters in *Terminalia arjuna* are presented in Table 2. Analysis of the data indicated considerable variation in height, with mean values ranging from 7.97 to 11.37 meters. The tallest tree, measuring 11.37 meters, was recorded in genotype MB-4, while the shortest, at 7.97 meters, was observed in Wan-13. Similarly, a significant variation was noted in diameter at breast height (DBH), with mean values between 20.17 and 27.22 meters. The highest DBH of 27.22 meters was observed in Wan-16, whereas the lowest, 20.17 meters, was recorded in MB-5. Canopy spread also showed notable variation, ranging from 4.23 to 8.73 meters. The widest canopy spread, 8.73 meters, was found in Wan-11. The minimum canopy spread 4.23 m was observed in MB-5. Toky *et al.* (1996) while working on *Albizialebbek* and Townsend (1977) in *Acer rubrum* have also reported significant variation in the height and diameter growth of different provenances. Kumar *et al.* (2005) significant variation in height and diameter of *Dalbergia sissoo.*

Tables 3 presents the data on tannin content in the bark, leaves, and fruits of *Terminalia arjuna,* which revealed significant differences among the samples.

Table 2. Physical parameter of *Terminalia arjuna* in different location of Akola and Amravati Districts.

Sl. No.	Tree no.	Height (m)	DBH (cm)	Canopy spread (m)
1	MB-1	9.47	25.23	8.52
2	MB-2	10.43	21.24	7.23
3	MB-3	9.03	20.32	6.58
4	MB-4	11.37	23.23	8.00
5	MB-5	9.77	20.17	4.23
6	Nag-6	8.87	21.22	4.40
7	Nag-7	9.57	20.19	4.42
8	Nag-8	11.10	26.39	6.80
9	Nag-9	9.33	22.52	5.77
10	Nag-10	10.17	26.75	5.15
11	Wan-11	10.00	22.10	8.73
12	Wan-12	9.47	21.03	6.75
13	Wan-13	7.97	21.22	8.14
14	Wan-14	6.47	20.35	8.37
15	Wan-15	8.47	26.8	6.28
16	Wan-16	8.27	27.22	4.75
17	Wan-17	9.07	25.13	5.82
18	Wan-18	10.03	21.10	5.65
19	Wan-19	10.97	23.33	7.70
20	Wan-20	9.47	25.5	7.88

Table 3. Tannin per cent in bark, leaves and fruits of *Terminalia arjuna.*

Sl. No.	Tree no.	Tannin in bark (%)	Tannin in leaves (%)	Tannin in fruits (%)
1	MB-1	10.74	4.69	6.28
2	MB-2	8.17	5.07	6.96
3	MB-3	11.87	4.55	9.46
4	MB-4	10.06	5.57	7.55
5	MB-5	8.32	5.37	6.96
6	Nag-6	8.09	5.19	5.22
7	Nag-7	8.02	6.26	7.95
8	Nag-8	11.72	4.84	6.58
9	Nag-9	9.76	5.48	6.43
10	Nag-10	11.42	4.62	6.96
11	Wan-11	7.26	5.68	5.52
12	Wan-12	7.49	4.77	6.35
13	Wan-13	7.41	4.77	6.64
14	Wan-14	7.19	6.96	6.81
15	Wan-15	6.88	5.37	6.28
16	Wan-16	13.76	4.69	5.83
17	Wan-17	12.71	5.75	6.05
18	Wan-18	11.19	4.57	5.83
19	Wan-19	8.47	4.47	6.51
20	Wan-20	8.25	4.92	7.04

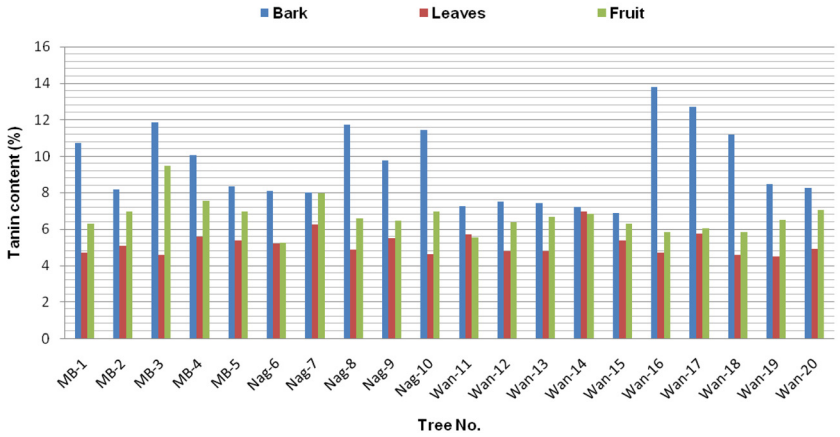

Fig. 1. Tannin per cent in bark, leaves and fruits of *Terminalia arjuna.*

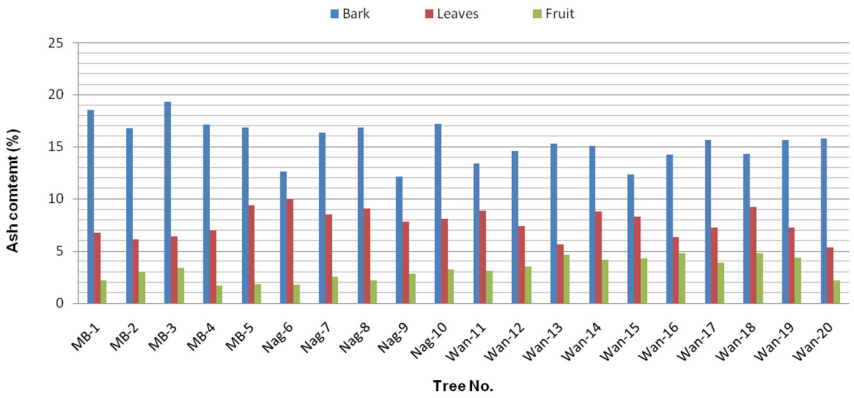

Fig. 2. Ash per cent in bark, leaves and fruits of *Terminalia arjuna*.

In the bark, the highest tannin content (13.76%) was recorded in Wan-16, while the lowest (7.19%) was observed in Wan-14. In the case of leaves, the maximum tannin content (6.96%) was found in Wan-14, whereas the minimum (4.47%) was noted in Wan-19. As for the fruits, MB-3 exhibited the highest tannin content (9.46%), and the lowest (5.22%) was recorded in Nag-6. Tannin content (Fig. 1) shown in variability form gives immense measures for *T. arjuna.* Pandey and Kori (2009) studied variation in tannin content that is ranged from 6.75 to 14.82 g per 100 g. Singh and Sharma (2011) also observed similar results in case of *T. chebula* fruits. Similar type of results of tannin content in bark, leaves and fruits were reported by Patil and Gaikwad (2011a and 2011b) Also, Wadhai *et al*. (2019) revealed the same results for the tannin content for arjuna tree.

Table 4 highlights notable variation in ash content across the bark, leaves, and fruits of *Terminalia arjuna*. The highest ash content in the bark (19.33%) was observed in MB-3, while the lowest (12.13%) was recorded in Nag-9. In leaves, the maximum ash content (9.92%) was found in Nag-6, which was statistically at par with MB-5 (9.38%) and Wan-18 (9.21%). The minimum ash content in leaves (5.37%) was noted in Wan-20. The Fig. 2 shown the same results in graphical form which is more important to express variability of ash content in *T. arjuna.* Similarly, significant differences were observed in fruit ash content, with the highest value (4.82%) reported in Wan-18 and the lowest (1.70%) in MB-4. The similar

Table 4. Ash per cent in bark, leaves and fruits of *Terminalia arjuna.*

Sl. No.	Tree no.	Ash in bark (%)	Ash in leaves (%)	Ash in fruits (%)
1	MB-1	18.53	6.75	2.20
2	MB-2	16.78	6.15	2.93
3	MB-3	19.33	6.39	3.37
4	MB-4	17.08	6.97	1.70
5	MB-5	16.80	9.38	1.82
6	Nag-6	12.60	9.92	1.76
7	Nag-7	16.33	8.53	2.50
8	Nag-8	16.80	9.09	2.20
9	Nag-9	12.13	7.84	2.80
10	Nag-10	17.20	8.09	3.23
11	Wan-11	13.40	8.90	3.13
12	Wan-12	14.55	7.38	3.50
13	Wan-13	15.28	5.63	4.64
14	Wan-14	15.08	8.77	4.13
15	Wan-15	12.30	8.28	4.33
16	Wan-16	14.23	6.31	4.80
17	Wan-17	15.60	7.27	3.87
18	Wan-18	14.33	9.21	4.82
19	Wan-19	15.60	7.23	4.36
20	Wan-20	15.80	5.37	2.21

types of results of ash content in bark, leaves and fruits of *T. arjuna* were also reported by Singh and Sharma (2011) and Patil and Gaikwad (2011). Also, Wadhai *et al.* (2017) represents same revelation of the study.

CONCLUSION

Terminalia arjuna is a valuable medicinal tree species exhibiting significant variability in growth parameters and biochemical traits. Among the genotypes studied, Wan-16 and Wan-14 recorded the highest tannin content in bark (13.76%) and leaves (6.96%), respectively. Notable variations were also observed in height, DBH, canopy spread, and ash content, particularly in fruits, with Wan-18 showing the maximum value (4.82%). The findings suggest that trees from the Wan Wildlife Sanctuary possess greater potential for tannin accumulation, especially in the bark. Therefore, this region could be prioritized for the industrial and commercial extraction of tannins, with a focus on sustainable harvesting practices to utilize bark as the primary source.

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