



## Biochemical Evaluation of Some Medicinal Plants of Genus *Terminalia* (Combretaceae) of Marathwada Region in Maharashtra

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### Abstract

The seasonal variation of starch, total sugar and total carbohydrates content have been investigated from leaves, wood and bark of *Terminalia cuneata* Roth, *Terminalia bellerica* Roxb. *Terminalia chebula* Retz. and *Terminalia catappa* Linn. are the medicinally important plant of Marathwada region. Comparative account of starch content of leaves, wood and bark of *Terminalia catappa* showed higher level (range 8.07 to 10.67 mg/g dry wt.) than *Terminalia cuneata* (range 6.44 to 8.46 mg/g dry/wt.), *Terminalia bellerica* (range 7.23 to 8.76 mg/g dry wt.) and *Terminalia chebula* (range 5.43 to 6.91 mg/g dry/wt.). Comparative account of total sugar content of leaves, wood and bark of *Terminalia catappa* showed higher level (range 2.81 to 3.31 mg/g dry wt.) than *Terminalia cuneata* (range 2.28 to 3.82 mg/g dry wt.), *Terminalia bellerica* (range 3.15 to 4.21 mg/g dry wt.) and *Terminalia chebula* (range 2.33 to 3.90 mg/g dry/wt.). Comparative account of total carbohydrate content of leaves, wood and bark of *Terminalia catappa* showed higher level (range 11.12 to 13.97 mg/g dry wt.) than *Terminalia cuneata* (range 8.72 to 11.85 mg/g dry wt.), *Terminalia bellerica* (range 10.53 to 12.98 mg/g dry wt.) and *Terminalia chebula* (range 7.76 to 10.81 mg/g dry/wt.).

**Keywords:** Starch, Total Sugar, Total Carbohydrate, Medicinal plant

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### 1. Introduction

Plants have always played a major role in the treatment of human traumas and diseases worldwide ( Principe *et al.*, 1991). They have been used as sources of modern drugs, either by providing pure compounds, starting materials for partial synthesis of useful compounds or models for synthesis of drugs (Hansel, 1972). According to the World Health Organization (WHO) as much as 80% of world's population depends on traditional medicine for their primary health care needs (Azaizeh *et al.* 2003). The knowledge of medicinal plants has been accumulated in the course of many centuries based on different medicinal system such as Ayurveda, Unani and Siddha. Developing

countries uses more than 80% traditional medicines for primary healthcare. (Farnsworth, N. and Soejarto, 1991) The herbal medicines are in global demand. (Srivastava, 2000). In India, the Ayurvedic medicines are estimated in market level at 20% annually (Subrat, 2002). All human beings required a number of complex organic/inorganic compounds in diet to meet the need for their activities. The important constituents of diet are carbohydrates, fats, proteins, vitamins, minerals and water (Indrayan *et al.*, 2005).

According to New Wall *et al.*, (1996), every constituent plays an important role and deficiency of any one constituent may lead to abnormal developments in the body. Plants are the rich source of all the elements essential for human beings. There is a relationship between the element content of the plant and its nutritional status. Some elements are essential for growth, for structure formation, reproduction or as components of biologically active molecules while other have some other beneficial effects. Carbohydrates perform numerous roles in living things. Polysaccharides serve for the storage of energy and as structural components. The 5-carbon monosaccharide ribose is an important component of coenzymes and the backbone of the genetic molecule known as RNA. Saccharides and their derivatives include many other important biomolecules that play key roles in the immune system, fertilization, preventing pathogenesis, blood clotting, and development.

## 2. Materials and Methods

Carbohydrates were estimated by methods suggested by McGready (1950), and Nelson (1941):

### Reagents:

- Somogy's reagent (4gm  $\text{CuSO}_4 + 24$  gm Anhydrous  $\text{Na}_2\text{CO}_3 + 16$ gm Na-K tartarate (Rocheette salt) + 180gm Anhydrous  $\text{Na}_2\text{SO}_4$ ).
- Nelson arsenomolybdate reagent :- (24gm  $(\text{NH}_4)_6\text{MO}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}$  (Ammonium molybdate) + (3gm  $\text{Na}_2\text{SO}_4 \cdot 7\text{H}_2\text{O}$ ). Both solution were mixed and incubated at  $37^\circ\text{C}$  for 24 hours before use and stored in brown bottle.
- Standard sugar solution was prepared by dissolving 10 mg of glucose in 100 ml distilled water.

### Procedure:

1 gm of sample were crushed with 10 ml 80% ethanol in mortar by adding acid free sand then filtered through filter paper. The filtrate and residue were collected separately. The alcoholic residue was taken in 250ml in conical flask. 150ml distilled water & 5ml conc. HCL were added to it. Hydrolyzed for 30 minutes and cooled to room temperature.  $\text{Na}_2\text{CO}_3$  was added bit-by-bit until the extract became neutral (pH=7). The extract was filtrated. Residue was discarded. Total volume of filtered was served as a sample for starch. First filtrate was taken in conical flask and condensed on water bath unto 2-3 minutes and cooled to room temperature. Lead acetate and K-oxalate 2 gm each (1:1) were in 15 ml of distilled water added to the filtrate and then filtered after mixing. Residue was discarded and the volume of filtrate was served for reducing sugar.

20 ml of this filtrate was taken in 150 ml conical flask, 2 ml of conical flask; 2 ml conc.HCL was added to it and corked. It was then hydrolyzed for 30 minutes and cooled at room temperature.  $\text{Na}_2\text{CO}_3$  was added bit-by-bit until the extract became neutral (pH=7). Then this extract was filtered and residue was discarded. The final volume of the filtrate was measured. It was served as a sample for total sugar. 0.5 ml of aliquot sample was taken in each test tube and 1 ml of Somogy's reagent was added to it. All tubes were placed in boiling water bath for 30 minutes, cooled the tubes to room temperature and 1 ml of arsenomolybdate reagent which is poisonous ) was added to it. The content was mixed thoroughly. Then the contents were diluted to a total volume of 10 ml and its absorbance measure OD at 560 nm in spectrophotometer.

## 3. Results and Discussion

### *Terminalia cuneata* Roth.

The plant parts leaves, bark and wood of *Terminalia cuneata* Roth. in summer, monsoon and winter showed almost identical range of starch, total sugar and total carbohydrates for two years of investigation (Table No. 1). The wood is the richest source of starch, which contain (8.23 mg/g to 8.46 mg/g) starch, as compared to bark (6.44 mg/g to 6.95 mg/g) and leaves (7.24 mg/g to 7.70 mg/g), the concentration of starch was in increasing order of bark < wood < leaves. The range of total sugar was also noted higher in wood i.e. in the range of (3.35 mg/g to 3.82 mg/g), than that of the leaves (3.14 mg/g to 3.36 mg/g) and in the bark, total sugar was recorded in the range of 2.28 mg/g to 2.76 mg/g which was lowest, compared to leaves and wood, the concentration of total starch was found in the increasing order of bark < leaves < wood. (Table No.1). The range of total carbohydrates contain in the wood showed maximum level of concentration (11.58 % to 12.28 %), the total carbohydrate concentration of leaves was found higher in summer season (11.06 %) than winter (10.66 %) monsoon (10.38 %) the total carbohydrate concentration of bark was in the range of (8.72 %) to (9.71 %) where it was found more in summer season (9.71%) than winter (9.15%) and monsoon (8.72 %). The concentration of total carbohydrate were found to be in the increasing order of bark < leaves < wood (Table No.1).

***Terminalia bellerica* Roxb.**

Total sugar, starch and total carbohydrates content of *Terminalia bellerica* Roxb. was recorded higher in wood than that of the leaves and bark. The continuous investigation of two years showed that leaves of the present plant accumulated total carbohydrates in the ranges of 11.33 % 11.90 % higher level of carbohydrates observed at summer season (11.9 %), than that of winter (11.49 %) and monsoon (11.33 %). In wood, it was recorded higher concentration of total carbohydrates in summer season (12.98 %), than winter (12.77 %) and monsoon (11.58 %), highest concentration was found in season summer in the bark of the same plant. Accumulation of total sugar was also studied, which gave data like 11.37 % of total carbohydrates concentration was found in summer, than 11.06 % concentration of total sugar was noted in the season of winter and monsoon showed concentration i.e. 10.53 %, the total sugar, of the percentage of concentration of total sugar was found in the increasing order bark < leaves < wood (Table No.1). The total sugar of wood again found highest in the same plant, that is in the range of (3.15 % to 4.22 %) where summer showed highest accumulation of total sugar (4.22 %) than that of winter (4.21 %) and monsoon season (3.15 %), in leaves total sugar accumulation was noted in the range of 3.19 % to 3.43 %, highest was noted in summer (3.43 %) than that of winter (3.25 %) and monsoon (3.19 %) while in bark, the range of total sugar was found (3.3 % to 3.89%), highest level was found in summer season (3.89 %), than winter (3.63 %) and monsoon (3.3 %), the total sugar accumulation was found highest in the season of summer (4.22%) and lowest in leaves, in the season of monsoon (3.19 %). The percentage of total sugar were found to be in increasing order of leaves < bark < wood. (Table No.1).

The starch concentration in the leaves was found in the range of (8.08 % to 8.47 %), where highest concentration was found in the season of summer (8.47 %) than winter (8.24 %) and monsoon (8.08 %). In the wood of the *Terminalia bellerica* Roxb. accumulation of starch observed highest in summer season (8.76 %), than winter (8.56 %) and monsoon (8.43 %). In the bark, the concentration of starch was in the range of (7.23 % to 7.48 %), where highest was noted in the summer season (7.48 %) than winter (7.43 %) and monsoon (7.23 %). (Table No.1). The concentration of starch in bark was low, than other plant parts i.e. leaves and wood, in the bark it was found in the range of 7.23% to 7.48%, where, in the summer it was found highest (7.48%), than winter (7.43%) and monsoon (7.23%) In the wood it was noted in the range of (8.43% to 8.76%), where highest was recorded in summer season (8.75%). In the leaves it was in the range of (8.08 to 8.47%), highest was noted in summer season (8.58%). The concentration of starch were found to be increasing order of bark < leaves < wood (Table No.1).

***Terminalia chebula* Retz.**

The starch content of leaves of *Terminalia chebula* Retz. was found in the range of 6.15% to 6.61 %, where the summer season showed highest concentration (6.61 %), than winter (6.25 %) and monsoon (6.15 %). In wood of the test plant highest level was observed at summer season (6.91 %), as compared to winter (6.7 %) and monsoon (6.38 %), while bark of the same plant accumulated starch much more in the summer (5.94 %) than winter (5.69 %) and monsoon (5.43%). The percentage of starch in leaves of *Terminalia chebula* Retz. were found to be in the increasing order of bark < wood < leaves (Table No.1). The total sugar content of leaves and wood of *Terminalia chebula* Retz. was approximately same and in the bark of the tree accumulation of total sugar was found less than leaves and wood. In leaves of the plant total sugar ranges from (3.14 % to 3.46). Higher accumulation of total sugar observed in summer (3.46 %) than winter (3.39 %) and monsoon (3.14 %). The range of total sugar content of wood was found in between 3.36 % to 3.9 %, it was slight higher than leaves and bark, higher level observed in summer (3.9 %), than winter (3.53 %) and monsoon (3.36 %), while in bark, higher accumulation of total sugar was found in summer season (2.79 %) than in winter (2.63 %) and monsoon (2.33%). The percentage of total sugar in *Terminalia chebula* Retz. was found to be in the increasing order of bark < wood < leaves. (Table No.1).

The total carbohydrate content of leaves, bark and wood of *Terminalia chebula* Retz. were usually higher in summer season. The range of total carbohydrate content of leaves was (9.29 % to 10.07 %) where in summer accumulation of total carbohydrates was (10.07%) than in winter it was 9.64 % and in monsoon it was found lowest i.e. (9.29%). In the wood of the same plant, the content of total carbohydrates was found in between the range of (9.74 % to 10.81 %) where in the summer season the accumulation of total carbohydrate was highest (10.81 %) than winter (10.23 %) and monsoon (9.74%). The range of total carbohydrate content of bark of the test plant was in the range of (7.76 % to 8.73%) where, in summer season it was found highest (8.73%), as compared to winter (8.32 %) and monsoon (7.76 %). The percentage of total carbohydrates were found to be in the increasing order of bark < leaves < wood (Table No.1).

***Terminalia catappa* Linn.**

The range of starch content of leaves *Terminalia catappa* Linn. was found in between 8.07 to 9.67), as compared to monsoon (9.26 %) and winter (8.07 %), while in wood, higher accumulation of starch was found in summer season (10.67) than winter (10.47) and monsoon (10.26 %), In bark, the accumulation of starch was found more in season of

summer (10.26) than that of winter (9.85) and monsoon (9.54). The concentration of starch were found in the increasing order of leaves bark < leaves < wood. (Table No.1). The range of total sugar content of leaves of test plant was found from 2.81 % to 3.05 %, during different seasons. The total sugar was found in summer season (3.18 %), which was higher than that of winter (3.05 %) and monsoon (2.81%), while in bark total sugar accumulated in the range of 3.14 % to 3.31%, higher level of total sugar was observed in summer season (3.31%), than winter (3.23 %) and monsoon (3.14%). The accumulation of total sugar in wood was found in the range of 2.83 % to 3.30%, where in the summer season the accumulation of total sugar was noted more (3.30%) than winter (3.18%) and monsoon (2.83%). The concentration of total sugar in *Terminalia catappa* Linn were found to be in the increasing order of leaves < wood < bark. (Table No.1).

The carbohydrates content of leaves was found higher in summer season (12.94%), than monsoon (12.07 %) and winter (11.12 %). The concentration of total carbohydrates content of wood was found in the range of 13.9% to 13.97 %, higher concentration was observed in summer season (13.65%) as compared to winter (13.65 %) and monsoon (13.09 %). In the bark of the test plant the accumulation of total carbohydrates was noted in the range of (12.68% to 13.57 %), where higher level of content of total carbohydrates was observed at summer season (13.57 %) than winter 13.08 % and monsoon 12.68 %. The total carbohydrates concentration were found to be in the increasing order of leaves < bark < wood. (Table No.1).

**Table 1 A:** Seasonal variation of total carbohydrates levels of different plant parts of 1) *Terminalia cuneata* Roth., 2) *Terminalia bellerica* Roxb., 3) *Terminalia chebula* Retz. and 4) *Terminalia catappa* Linn.

Plant parts	Seasons	Starch (mg/g dry wt.)			
		Plant 1	Plant 2	Plant 3	Plant 4
Leaves	Summer	7.70	8.47	6.61	9.76
	Monsoon	7.24	8.08	6.15	9.26
	Winter	7.39	8.24	6.25	8.07
Wood	Summer	8.46	8.76	6.91	10.67
	Monsoon	8.23	8.43	6.38	10.26
	Winter	8.34	8.56	6.7	10.47
Bark	Summer	6.95	7.48	5.94	10.26
	Monsoon	6.44	7.23	5.43	9.54
	Winter	6.72	7.43	5.69	9.85

**Table 1 B:** Seasonal variation of total carbohydrates levels of different plant parts of 1) *Terminalia cuneata* Roth., 2) *Terminalia bellerica* Roxb., 3) *Terminalia chebula* Retz. and 4) *Terminalia catappa* Linn.

Plant parts	Seasons	Total Sugar (mg/g dry wt.)			
		Plant 1	Plant 2	Plant 3	Plant 4
Leaves	Summer	3.36	3.43	3.46	3.18
	Monsoon	3.14	3.19	3.14	2.81
	Winter	3.27	3.25	3.39	3.05
Wood	Summer	3.82	4.22	3.9	3.30
	Monsoon	3.35	3.15	3.36	2.83
	Winter	3.51	4.21	3.53	3.18
Bark	Summer	2.76	3.89	2.79	3.31
	Monsoon	2.28	3.3	2.33	3.14
	Winter	2.43	3.63	2.63	3.23

**Table 1 C:** Seasonal variation of total carbohydrates levels of different plant parts of 1) *Terminalia cuneata* Roth., 2) *Terminalia bellerica* Roxb. , 3) *Terminalia chebula* Retz. and 4) *Terminalia catappa* Linn.

Plant parts	Seasons	Total Carbohydrates (mg/g dry wt.)			
		Plant 1	Plant 2	Plant 3	Plant 4
Leaves	Summer	11.06	11.90	10.07	12.94
	Monsoon	10.38	11.33	9.29	12.07
	Winter	10.66	11.49	9.64	11.12
Wood	Summer	12.28	12.98	10.81	13.97
	Monsoon	11.58	11.58	9.74	13.09
	Winter	11.85	12.77	10.23	13.65
Bark	Summer	9.71	11.37	8.73	13.57
	Monsoon	8.72	10.53	7.76	12.68
	Winter	9.15	11.06	8.32	13.08

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