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Studies on Physico-chemical evaluation of tamarind (*Tamarindus indica* L.) genotypes prevailing in bastar region of Chhattisgarh on micro nutrient status of tamarind pulp

Amit kumar Shukla and Jitendra Singh

Abstract
The present investigation entitled "Studies on physico-chemical evaluation of tamarind (*Tamarindus indica* L.) genotypes prevailing in Bastar region of Chhattisgarh" was carried out in the laboratory, Department of Horticulture, College of Agriculture, IGAU, Raipur (C.G.) during the year 2004-05 and 2005-06. The study was carried out with 16 treatments (genotypes) consist of ripe fruits collected from selected trees of tamarind exist in Tokapal and Jadavpur block of Bastar district (C.G.) under Randomized Block Design with three replications. Higher Fe content of pulp recorded in IGTAM-15 (9.93 mg/100g) and lower Fe content of pulp was recorded in IGTAM-5 (1.58 mg/100g).Maximum copper content of pulp was noticed in IGTAM-15 (19.10 mg/100g)and minimum copper content of pulp was noticed in IGTAM-9 (5.45 mg/100g).Higher Na content of pulp was recorded in IGTAM-15 (55.70 mg/100g)and lower Na content of pulp was recorded in IGTAM-11 (3.00 mg/100g).

Keywords: Tamarind, iron, copper, zinc and sodium

Introduction
Tamarind (*Tamarindus indica* L.) is a hardy evergreen monotypic tree which belongs to the family 'Leguminosae' and sub-family Caesalpinaceae and has the chromosome number 2n=24. The name tamarind was derived from the Arabic word 'Tamar-E-Hind' meaning 'Date of India'. It is cultivated throughout the tropics and sub-tropics of the world and has become naturalized at many places.

Tamarind is an economically important tree of India as well as Chhattisgarh. In India, it is abundantly grown in Madhya Pradesh, Bihar, Andhra Pradesh, Tamil Nadu and Karnataka.

In India, tamarind is one of the most important common fruit trees and it is under cultivation for several centuries. Almost every part of it finds some use, but the most important is the fruit pulp which is the richest source of tartaric acid. It is being used in the manufacture of several products such as tamarind juice concentrate, pulp powder, pectin, pickle, chutneys, sauces, soups, jam, syrups, candy, tartaric acid, alcohol, refreshing tamarind drinks and tamarind kernel powder.

In India, few improved varieties of tamarind are in existence, like PKM-1 of Periyakulam, Pratisthan of Maharashtra and Urigam of Tamil Nadu (Geetha, 1995) [4]. Looking to the large area of tamarind either in forest or in homestead of tribal people.

Materials and method
1. Iron, copper and zinc
Lindsay and Norvell (1978) developed a method using DTPA (Diethylene Triamine Penta Acetic Acid) for the extraction of available Fe, Mn, Cu and Zn.

2. Sodium
Sodium (Na) was determined by flame photometer method as described by Chapman and Pratt (1961)

Results and discussion
1. Iron (pulp)
Data obtained on iron (Fe) content of pulp are presented in Table 1

It is obvious from the data that iron content of pulp in different genotypes included in this study ranged between 1.90 mg/100g (IGTAM-5) to 9.43 mg/100g (IGTAM-15) during 1st year (2004-06), 1.91 mg/100g (IGTAM-5) to 9.93 mg/100g (IGTAM-15) during 2nd year (2005-06) and 1.90 mg/100g (IGTAM-5) to 9.38 mg/100g (IGTAM-15) in case of pooled data (mean of both the years). Significant difference was observed among the genotypes in respect of iron content of pulp during 1st year and 2nd year of study as well as in pooled data basis.

During 1st year (2004-05), the highest iron content of pulp was recorded in IGTAM-15 (9.43 mg/100g) which was found exceptionally better than all the genotypes studied in this investigation. This genotype (IGTAM-15) was followed by IGTAM-16 (7.81 mg/100g), IGTAM-11 (6.50 mg/100g) and IGTAM-1 (5.49 mg/100g). The lowest iron content of pulp was observed in IGTAM-5 (1.90 mg/100g).

Table 1: Variation in mineral composition of different Tamarind genotypes (Fe content of pulp)

Treatments	Iron (mg/100 g)		
	2004-05	2005-06	Pooled
IGTAM-1	5.49	5.48	5.49
IGTAM-2	3.20	3.20	3.20
IGTAM-3	2.31	2.31	2.32
IGTAM-4	4.23	4.28	4.26
IGTAM-5	1.90	1.91	1.90
IGTAM-6	4.18	4.22	4.20
IGTAM-7	5.00	5.06	5.03
IGTAM-8	5.18	5.20	5.19
IGTAM-9	3.33	3.30	3.31
IGTAM-10	3.00	3.08	3.04
IGTAM-11	6.50	6.46	6.48
IGTAM-12	4.18	4.20	4.19
IGTAM-13	2.20	2.12	2.13
IGTAM-14	5.23	5.27	5.25
IGTAM-15	9.43	9.33	9.38
IGTAM-16	7.81	7.81	7.81
SE(m)±	0.0228	0.0256	0.0226
CD (5%)	0.07	0.07	0.07

During 2nd year (2005-06), the maximum iron content of pulp was observed in IGTAM-15 (9.93 mg/100g), which was found remarkably better than all the genotypes studied in this investigation. This genotype (IGTAM-15) was followed by IGTAM-16 (7.81 mg/100g), IGTAM-11 (6.46 mg/100g) and IGTAM-1 (5.48 mg/100g). The minimum iron content of pulp was recorded in IGTAM-5 (1.91 mg/100g).

In case of pooled, data the maximum iron content of pulp was noticed in IGTAM-15 (9.38 mg/100g), which was found exceptionally better than all the genotypes studied in this investigation. This genotype (IGTAM-15) was followed by IGTAM-16 (7.81 mg/100g), IGTAM-11 (6.48 mg/100g) and IGTAM-1 (5.49 mg/100g). The minimum iron content of pulp was recorded in IGTAM-5 (1.90 mg/100g).

Thus, it is obvious from the data that highest iron content of pulp was noticed in IGTAM-15 and lowest iron content of pulp was recorded in IGTAM-5 in case of both the years as well as in pooled data. In the present investigation, variations were also observed in iron (Fe) content of pulp among the different tamarind genotypes studied (Table 1)

The maximum the maximum iron content of pulp was recorded in IGTAM-15 (9.93 mg/100g) and minimum iron content of pulp in IGTAM-5 (1.58 mg/100g). The difference in minerals (Fe) content of pulp may be due to genetic nature of the genotypes. The results are also in close agreement with the findings of Ishola *et al.* (1990) [5], who reported that tamarind pulp contain magnesium (72.00 mg/100g), copper (21.8 mg/100g) and iron (1.30-10.90 mg/100g). Similar results on Mg, Cu and Fe content of tamarind pulp have been reported by Bhattacharya *et al.* (1994) [2] and Parvez *et al.* (2003) [8].

2.Copper (pulp)

Data gathered on copper (Cu) content of pulp are furnished in Table 2

The data reveal that copper content of pulp in different genotypes included in this study ranged from 5.48 mg/100g (IGTAM-9) to 19.09 mg/100g (IGTAM-15) during 1st year (2004-05), 5.45 mg/100g (IGTAM-9) to 19.10 mg/100g (IGTAM-15) during 2nd year (2005-06) and 5.47 mg/100g (IGTAM-9) to 19.10 mg/100g (IGTAM-15) in case of pooled data (mean of both the years). Significant different was observed among the genotypes in respect of copper content of pulp during 1st year and 2nd year of the study as well as in pooled basis.

During 1st year (2004-05), the maximum copper content of pulp was recorded in IGTAM-15 (19.09 mg/100g) which was found excellent than all the genotypes studied in this investigation. This genotype (IGTAM-15) was followed by IGTAM-16 (17.03 mg/100g), IGTAM-1 (15.39 mg/100) and IGTAM-14 (15.39 mg/100g). The minimum copper content of pulp was recorded in IGTAM-9 (5.48 mg/100g).

During 2nd year (2005-06), the highest copper content of pulp was recorded in IGTAM-15 (19.10 mg/100g) which was found excellent than all the other genotypes studied in this investigation. This genotype (IGTAM-15) was followed by IGTAM-16 (17.10 mg/100g), IGTAM-1 (15.47 mg/100g) and IGTAM-14 (14.38 mg/100g). The lowest copper content of pulp was observed in IGTAM-9 (5.45 mg/100g).

Table 1: Variation in mineral composition of different Tamarind genotypes (Fe content of pulp)

Treatments	Copper (mg/100 g)		
	2004-05	2005-06	Pooled
IGTAM-1	15.39	15.47	15.43
IGTAM-2	10.17	10.22	10.20
IGTAM-3	8.16	8.27	8.22
IGTAM-4	6.91	6.97	6.94
IGTAM-5	9.15	9.20	9.18
IGTAM-6	6.00	6.07	6.03
IGTAM-7	12.08	12.12	12.10
IGTAM-8	11.17	11.17	11.17
IGTAM-9	5.48	5.45	5.47
IGTAM-10	8.89	8.83	8.86
IGTAM-11	12.86	13.21	13.21
IGTAM-12	10.29	10.29	10.29
IGTAM-13	12.00	12.05	12.02
IGTAM-14	14.40	14.38	14.39
IGTAM-15	19.09	19.10	19.10
IGTAM-16	17.03	17.10	17.07
SE(m)±	0.0965	0.0255	0.0253
CD (5%)	0.28	0.07	0.07

In case of pooled data, maximum copper content of pulp was recorded in IGTAM-15 (19.10 mg/100g) which was found excellent than all the genotypes studied in this investigation. This genotype (IGTAM-15) was followed by IGTAM-16 (17.07 mg/100g), IGTAM-1 (15.43 mg/100g) and IGTAM-14 (14.39 mg/100g). The minimum copper content of pulp was

observed in IGTAM-9 (5.47 mg/100g).
Thus, the data presented on copper content of pulp clearly show that higher copper content of pulp was recorded on IGTAM-15 and lower copper content of pulp in IGTAM-9 in case of 1st year and 2nd year of the study as well as in pooled data.

3. Zinc (pulp)
The Zinc (Zn) content of pulp was determined for all the genotypes included in this study during both 1st year (2004-05) and 2nd year (2005-06) and it was observed that zinc content of pulp was found nil in all the genotypes studied in this investigation except IGTAM-9 and IGTAM-8. Thus, the data are not presented.
During 1st year (2004-05), maximum zinc content of pulp was observed in IGTAM-9 (0.52 mg/100g) which was followed by IGTAM-8 (0.40 mg/100g).
During 2nd year (2005-06), highest zinc content of pulp was recorded in IGTAM-9 (0.51 mg/100g) which was followed by IGTAM-8 (0.43 mg/100g).
In case of pooled mean (mean of both the years), maximum zinc content of pulp was observed in IGTAM-9 (0.51 mg/100g) which was followed by IGTAM-8 (0.42 mg/100g).
In the present investigation, variations were also observed in Copper (Cu) content of pulp among the different tamarind genotypes studied (Table 3)
The zinc (Zn) content of pulp was recorded maximum in IGTAM-9 (0.52 mg/100g) and minimum zinc content in IGTAM-8 (0.40 mg/100g).
In present investigation it was observed that zinc content of pulp among different genotypes of tamarind studied was found nil in 14 genotypes out of 16 genotype studied and only two genotypes had recorded zinc content of pulp. The observation regarding zinc (Zn) content of tamarind pulp was 1.10 (mg/100g) by Ishola *et al*. (1990) [5], 0.8 to 0.9 mg/100g by Parvez *et al*. (2003) [8] and these results are in line with the present findings.

4. Sodium (pulp)
The data pertaining to sodium (Na) content of pulp are furnished in Table 3.
A perusal of data indicates that sodium content of pulp in different genotypes included in this study varied from 3.03 mg/100g (IGTAM-11) to 55.28 mg/100g (IGTAM-15) during 1st year (2004-05), 3.00 mg/100g (IGTAM-11) to 55.70 mg/100g (IGTAM-15) during 2nd year (2005-06) and 3.02 mg/100g (IGTAM-11) to 55.49 mg/100g (IGTAM-15) in case of pooled data (mean of both the years). Significant difference was observed among the genotypes in respect of sodium content of pulp during 1st year and 2nd year of study as well as in pooled data.
During 1st year (2004-05), the maximum sodium content of pulp was recorded in IGTAM-15 (55.28 mg/100g), which was found significantly higher than all the other genotypes studied in this investigation. This genotype (IGTAM-15) was followed by IGTAM-8 (50.35 mg/100g) IGTAM-16 (45.74 mg/100g) and IGTAM-9 (40.30

Table 3: Variation in mineral composition of different tamarind genotypes (Na content of pulp)

Treatments	Sodium (mg/100 g)		
	2004-05	2005-06	Pooled
IGTAM-1	30.46	30.93	30.73
IGTAM-2	20.34	20.94	20.64
IGTAM-3	6.08	6.08	6.08
IGTAM-4	8.30	8.15	8.23
IGTAM-5	15.44	15.86	15.49
IGTAM-6	19.26	19.24	19.25
IGTAM-7	4.09	4.00	4.05
IGTAM-8	50.35	50.77	50.56
IGTAM-9	40.30	40.65	40.48
IGTAM-10	32.39	32.62	32.51
IGTAM-11	3.03	3.00	3.02
IGTAM-12	21.27	21.51	21.39
IGTAM-13	5.29	5.12	5.21
IGTAM-14	10.28	10.75	10.52
IGTAM-15	55.28	55.70	55.49
IGTAM-16	45.74	45.87	45.80
SE(m)±	0.0299	0.1821	0.082
CD (5%)	0.09	0.53	0.24

mg/100g). The minimum sodium content of pulp was noticed in IGTAM-11 (3.03 mg/100g).
During 2nd year (2005-06), the highest sodium content of pulp was recorded in IGTAM-15 (55.70 mg/100g) which was found significantly excellent than all the other genotypes studied in this investigation. This genotype (IGTAM-15) was followed by IGTAM-8 (50.77 mg/100g), IGTAM-16 (45.87 mg/100g) and IGTAM-9 (40.65 mg/100g). The lowest sodium content of pulp was observed in IGTAM-11 (3.00 mg/100g).
In case of pooled data, maximum sodium content of pulp was recorded in IGTAM-15 (55.49 mg/100g), which was found significantly better than all the genotypes studied in this investigation. This genotype (IGTAM-15) was followed by IGTAM-8 (50.56 mg/100g), IGTAM-16 (45.80 mg/100g) and IGTAM-9 (40.48 mg/100g). The minimum sodium content of pulp was observed in IGTAM-11 (3.00 mg/100g).
Thus, the data presented on sodium content of pulp clearly show that highest sodium content of pulp was observed in IGTAM-15 and lowest sodium content of pulp was recorded in IGTAM-11, in case of both the years as well as in pooled data.
The data presented in Table 4. indicates significant variation among the genotypes included in this study in respect of sodium (Na) content of tamarind pulp.
The sodium content of pulp varied between 3.00 mg/100g (IGTAM-11) to 55.70 mg/100g (IGTAM-15).
The difference in mineral (Na) content of tamarind pulp might

be due to genetic nature of the genotypes. These results are supported by the findings of Ishola *et al*. (1990) [5], Sodium 3.0 to 76.7 mg/100g. Similar results on Na was also reported by Bhattacharya *et al*. (1994) [2] and Parvez *et al*. (2003) [8].

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