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Estimation of non-structural carbohydrates, protein and minerals of selected wild-edible fruits of Gujarat

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Abstract: *Fruits of five wild edible plants were selected for the study based on their uses by tribal and rural communities of Gujarat. All reported fruits were analyzed for their non-structural carbohydrate i.e. reducing, non-reducing and total sugars, total starch and total carbohydrate, protein, and minerals like Ca, Mg, Na, K, and Fe. Recorded value of total carbohydrate was maximum in Pithecellobium dulce 182.8 mg g^{-1} followed by Ziziphus mauritiana, Prosopis juliflora, and minimum in Capparis decidua 27.9. Total protein was highest in fruits of P. dulce (54.2 mg g^{-1}) and lowest in Trapa bispinosa (6.9 mg g^{-1}). Ca was highest in C. decidua (9.6 mg g^{-1}) and lowest in T. bispinosa (4.0 mg g^{-1}), Mg maximum in T. bispinosa (31.6 mg g^{-1}), and minimum in P. dulce (19.7 mg g^{-1}). Fruits of C. decidua contained highest Na i.e. 0.016 mg g^{-1} amongst all reported plant species. While K was highest in fruits of Z. mauritiana (1.24 mg g^{-1}) and was lowest in P. juliflora (0.07 mg g^{-1}). Fruits of all reported plant species contained a very low amount of Fe. It was maximum in fruits of C. decidua (0.113 mg $100g^{-1}$) amongst all reported fruits.*

Key Words: *Fruits, minerals, non-conventional plants, non-structural carbohydrates, protein.*

1. INTRODUCTION:

Over 50 million people live in Gujarat, belonging to different ethnicities, social groups, and religions (Mishra, 1996). According to the 2011 population census (Anonymous), the tribal population makes up about 21 % of the state's population. The indigenous people of these tribes possess a wealth of knowledge about the environs and its significance. As a result of years of close association with nature, today's ethnic groups possess a wealth of knowledge. Because of their realization that the edible, medicinal, and other wild plants are the vital source of life, they have preserved this knowledge. Markets and changing lifestyles seem to be destroying influence quickly (Shankara, 2002). There are many wild edible plants that the tribes use for their rescue. Certain factors contribute to this knowledge, such as availability, socioeconomic conditions, tradition, flavor and culture. Some of these plants are regularly consumed as staple foods, whereas others are not much used and are called underused plants, famine foods or non-conventional foods (Duhan et al., 1992; Lyimo et al., 2003). In majority of cases, wild edible species are collected for home consumption by forest dwellers, tribal communities and marginalized communities living in marginalized rural areas (Mahapatra et al., 2012). Biologically, wild edible plants contribute substantially to protein, minerals, and vitamin intake in rural areas where exotic species are not readily available (Mazava, 1995). An estimated 450 plant species have been identified for edible use in the arid zone, and approximately 30 have been identified for their raw or edible fruits. Their multi-purpose roles include soil cover, wind protection, fuel wood, and fodder as well as food. Despite this, they are often undervalued and underutilized, as a growing number of exotic fruits become more accessible. Some nutritional studies on a few fruits from the arid zone have been reported (Duhan *et al*., 1992; Mazava, 1995). Although most common foods have been extensively studied nutritionally, there is little information on the nutritional value of some non-conventional fruits, which may contribute to significant nutrient intake (Duhan *et al*., 1992). As a result of this study, selected important fruit-bearing species from Gujarat have been analyzed concerning their nutritional content estimation, including carbohydrate, protein, and mineral content.

2. MATERIALS AND METHODS :

Details of underutilized Fruits is given in Table 1, they were procured from the wild and from local market during the season. They were brought to laboratory and washed thoroughly by tap water and then by distilled water. They were first air dried and then after oven dried at 60º till constant weight was obtained. Dried plant material was

ground, sieved through 60 mm meshes and stored in air-tight polythene bags under room temperature condition for further biochemical analysis.

Carbohydrate and Protein

Analysis of total carbohydrate was done following method given by Mahadevan and Sridhar (1996) and was calculated by addition of total sugar and total starch.

Analysis of total sugar was done following Nelson's method (1944). Procedure for analyzing reducing sugar was same as total sugar without hydrolysis and neutralization following Nelson's method (1944). Non-reducing sugar was analyzed by subtraction of reducing sugar from total sugar (Mahadevan and Sridhar, 1996). Total starch was calculated following conversion factor of 0.9 to total sugar (Mahadevan and Sridhar, 1996). Total protein analysis was done following Lowry's method (1951).

Mineral analysis

Analysis of minerals like Ca and Mg was done following method of Trivedi and Goel (1987); Na and K were estimated by using Flame photometer method and Fe by AOAC manual (1995).

Sample preparation for minerals was done by tri-acid digestion method following Trivedi and Goel (1987).

All data are represented in mg g^{-1} on dry wt. basis except Fe (mg 100 g^{-1}).

Statistical analysis

All tests were performed in five replicates and statistical analysis was carried out using statistical software MSTAT 4.0 C package for computers (Michigan State University, USA) software following the method of Gomez and Gomez (1976).

3. RESULTS AND DISCUSSION

Maximum energy required is fulfilled by carbohydrate rich food supplements of all non conventional fruits, reported appreciable amount of sugar, starch and carbohydrate (Table 2). Results revealed that maximum carbohydrate was found in fruits of *Pithecellobium dulce* and *Ziziphus mauritiana* followed by *Prosopis juliflora, Trapa bispinosa* and *Capparis deciduas* which is higher than other conventional fruits like apple (134 mg g^{-1}), orange (109 mg g^{-1}), papaya (72 mg g^{-1}) grapes (165 mg g^{-1}) and mango (169 mg g^{-1})

(Gopalan *et a1*., 1977). Recorded value of carbohydrate content in *Pithecellobium dulce* is higher than reported by Katewa (2003) i.e. 45.6 mg g^{-1}. Carbohydrate content of *Zizyphus mauritiana* was also higher than reported by Goswami and Yadav (1999) i.e 36 mg g^{-1} and Rathore and Meena (2004) i.e. 40.5 mg g^{-1} .

Protein provides building material to the human body, pregnant women and growing children. In the tribal areas, maximum malnutrition diseases occur due to protein deficiency and are maximum during summer. Many non-conventional fruits are rich source of dietary proteins. Fruits of *Pithecellobium dulce, Capparis decidua and Zizyphus mauritiana* supplies unique source of protein (Table 2). Fruits of *Pithecellobium dulce and Capparis decidua* and dried fruits of *Ziziphus mauritiana*; which are collected and preserved during winter also fulfill major protein requirements during summer. The protein content of reported fruits is higher than conventional fruits like apple (20 mg g^{-1}), banana (6 mg g^{-1}), dates (25 mg g^{-1}) and mango (6 mg g^{-1}) (Gopalan *et a1*., 1977). Protein content of *Pithecellobium dulce* was also very high than reported by Katewa (2003) i.e. 15 mg g^{-1}.

Minerals are required in low quantities in diet, but they perform specific functions in human body, most of the malnutrition disease occur due to deficiency of these minerals in diet. Most of the tribal are suffering from calcium and iron deficiency diseases. Results revealed that reported fruit species are rich in minerals like Ca, Mg and Fe. Calcium content of *Capparis deciduas* and *Zizyphus mauritiana* (Table 3) is very close to the calcium content of an apple (10 mg g^{-1}) (Gopalan *et a1*., 1977). Magnesium content of all reported species (Table 3)are higher than the conventional fruits like apple (7 mg g^{-1}), papaya (11 mg g^{-1}) and guava (21 mg g^{-1}) (Gopalan *et a1*., 1977). All reported species also supply moderate amount of sodium, potassium and iron (Table 3).

From the study, it was concluded that the fruits of reported plant species are good sources of dietary carbohydrates, protein, minerals like Ca, Mg and K. They also provide moderate quantities of Na and Fe. Most of these species are available before and during summer; when most of the conventional fruits are in short supply and at its high cost. Thus, these plants can be incorporated in diet to overcome various malnutrition diseases in children and women. Fruits of *Capparis deciduas, Ziziphus mauritiana* and *Trapa bispinosa* could play an important role in household food security during adverse conditions.

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Table 1. Details of selected fruits

Scientific name	Local name	English name	Family	Uses
Capparis decidua	Kerda	Leafless carper	Capparidaceae	Unripe fruits pickled, dried fruits used as vegetables after processing, plants are good soil binder.
Pithecellobium dulce	Vilayati amli	Manila tamarind	Mimosaceae	Planted as wind breakers or as shelter belts, unripe fruits are used as vegetables in times of scarcity, ripe fruits eaten raw.
Prosopis juliflora	Gando baval	Mosquite	Mimosaceae	Plant is a good soil binder and wind breaker. The dried pods are eaten with delight by tribal and rural people; it is also used as cattle feed.
Trapa bispinosa	Shingoda	Water chestnut	Trapaceae	Found abundantly in ponds and shallow water reservoirs, ripe fruits boiled with salt and eaten.
Ziziphus mauritiana	Bor	Indian jujube	Rhamnaceae	Ripe fruits eaten raw by children. Plant is also a good soil binder, wood is used as fuel.

Page-3 in materials and method

Table 2. Nonstructural carbohydrate and total protein content of selected non-conventional fruits.

Scientific Name	Total Sugar (mg g^{-1})	Reducing-Sugar (mg g^{-1})	Non-Reducing Sugar (mg g^{-1})	Total Starch (mg g^{-1})	Total Carbohydrate (mg g^{-1})	Total protein (mg g^{-1})
Capparis decidua	14.6 ±0.22	11.3 ±0.34	3.4 ±0.27	13.2 ±0.20	27.8 ±0.42	35.3 ±1.12
Prosopis juliflora	52.2± 0.04	6.2 ±0.07	45.9 ±0.03	46.9 ± 0.03	99.1 ±0.07	18.0 ±0.96
Trapa bispinosa	17.7± 0.15	6.7 ±0.15	10.9 ±0.13	15.9 ± 0.13	33.6 ±0.29	6.9 ±0.26
Zizyphus mauritiana	94.1± 0.66	77.5 ±0.01	16.7 ±0.12	84.7 ± 0.59	178.4 ±1.25	21.1 ±0.05
Pithecellobium dulce	96.2± 0.16	89.1 ±0.51	7.1 ±0.67	86.6 ± 0.14	182.8 ± 0.31	54.2 ±0.78

Page no 5. Data are mean value (n=5) ± SD

Table 3. Mineral contents of selected non-conventional fruits.

Scientific Name	Calcium (mg g^{-1})	Magnesium (mg g^{-1})	Sodium (mg g^{-1})	Potassium (mg g^{-1})	Iron (mg 100 g^{-1})
Capparis decidua	9.6± 0.39	22.4± 0.61	0.016± 0.011	0.41± 0.01	0.113± 0.001
Prosopis juliflora	5.6± 0.2	25.8± 0.2	0.003± 0.001	0.07± 0.02	0.019± 0.001
Trapa bispinosa	4.0± 0.2	31.6±0.2	0.003± 0.002	0.43± 0.03	0.068± 0.001
Zizyphus mauritian	8.8± 0.10	25.3± 0.22	0.002± 0.001	1.24± 0.04	0.054± 0.002
Pithecellobium dulce	6.4± 0.02	19.7± 0.27	0.004± 0.001	0.62± 0.02	0.034± 0.005

Page no 5. Data are mean value (n=5) ± SD