Indigenous Practices in Wild Vegetables and Fruits

• A Dialogue with Community •

स्वच्छ भारत

एक कदम स्वच्छता की ओर

Indigenous Practices in

Wild Vegetables

and

Fruits

A Dialogue with Community

विद्यया ऽमृतमश्नुते

एन सी ई आर टी
NCERT

राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

18204 – Indigenous Practices in Wild Vegetables and Fruits — A Dialogue with Community

ISBN 978-93-5292-854-5

First Edition

May 2024 Baishakh 1946

PD 2T BS

₹ 235.00

Printed on 80 GSM paper

Published at the Publication Division by the Secretary, National Council of Educational Research and Training, Sri Aurobindo Marg, New Delhi 110 016, and printed at Taj Printers, 69/6A, Najafgarh Road Industrial Area, Near Kirti Nagar Metro Station, New Delhi - 110 015

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Foreword

The National Education Policy 2020 (NEP 2020) has emphasised on redesigning the curriculum and pedagogy strongly rooted in the Indian and local context and ethos in terms of culture, traditions, heritage, customs, language and so on. The policy also recommends the Indian knowledge systems, including tribal knowledge, to be integrated in various disciplines.

Taking into account the concerns of NEP 2020, the Department of Education in Science and Mathematics (DESM), National Council of Educational Research and Training (NCERT), New Delhi organised two consecutive National Interactive Meets on 'Indigenous Knowledge on Wild Vegetables and Fruits and their Conservation' in the years 2022 and 2023. These two National Interactive Meets were envisaged to provide a platform to discuss and strengthen the indigenous knowledge and practices followed by scheduled tribe communities for identification, gathering and utilisation of wild vegetables and fruits and their *in situ* conservation. During the meet, scientists, doctors and academicians working in formal institutions, independent scholars, freelancers and resource persons from scheduled tribe communities participated and discussed the precious indigenous knowledge which they have gained through their age-old traditional practices.

The book titled 'Indigenous Practices in Wild Vegetables and Fruits: A Dialogue with Community' comprises of research papers, articles, compendium of wild edibles showcased by different scheduled tribe community resource persons and also discusses the way forward. This book will be a valuable resource for the teachers teaching in diverse geographic locations of the country including tribal areas for contextual curriculum transaction and will also provide new insights to policymakers, curriculum developers, textbook writers, researchers and others working in the field of Indian Knowledge System.

Scientists, academicians from various institutions and resource persons from scheduled tribe communities have contributed to the development of this book. We are thankful to all the individuals and organisations who have put their efforts and made this endeavour possible. I appreciate the efforts and academic contribution of Sunita Farkya, *Professor* and *Head*, Department of Education in Science and Mathematics, as an academic editor, for bringing out this material in the form of a book.

I hope all the policymakers, curriculum developers, textbook writers, researchers, teachers, teacher educators and others will benefit from this material.

Dinesh Prasad Saklani
Director
National Council of Educational Research and Training

New Delhi

Preface

The present book is the proceedings of 'National Interactive Meet on Wild Vegetables and Fruits and their Conservation' organised by the Department of Education in Science and Mathematics, National Council of Educational Research and Training, New Delhi. The National Meet provided a common platform to all stakeholders working in the field of Indian Knowledge System, especially in the field of wild vegetables and fruits, who gathered, utilised and made efforts for their *in situ* conservation by Scheduled Tribe community. The unique feature of this National Meet was that the Scheduled Tribe community representatives were involved as 'resource of indigenous knowledge'. In this National Interactive Meet, around 100 resource persons from Scheduled Tribe community, scientists, academicians and freelancers participated, shared their views and displayed wild vegetables and fruits, representing approximately 20 tribal communities hailing from 11 States of India.

The National Meet was envisaged keeping in view the guiding principles of National Education Policy 2020, that is, go back to our roots and create a future of our own strengths. The policy lays strong emphasis on realising the importance of and taking pride in our own knowledge system; and to come out strongly from long etched colonial historical roots in collective Indian psyche. Thus, this is quintessential to not only generate a dialogue among the wider stakeholders from diverse sections of our society but also to conceptualise and develop an inclusive curricular framework which introduces and developes a deeper, critical understanding of our traditional knowledge systems in school education.

The book comprises of three parts; first part of the book contains research papers and articles contributed by experts, whereas second part of the book comprises of the compendium of wild edibles showcased by 'Community Resource' during the Interactive Meet and the third part comprehends the way forward, suggestions and conclusion as the end product of the event. This book will help teachers and learners to imbibe values regarding the indigenous practices and their importance in learning of science concepts. The concept of biodiversity conservation, values towards plants and value additions are some of the aspects entrenched within these indigenous practices.

This book will be a great resource for teachers teaching in diverse geographic locations of the country including tribal areas for contextual curriculum transaction. It will provide new insights to policy makers, curriculum developers, textbook writers, researchers and others working in the field of Indian Knowledge System. It will also be helpful during the curriculum reforms, development and delivery in all subject domains specifically in science education and environmental education, and also for achieving the Sustainable Development Goals. This book is expected to bring new perspectives for active involvement of indigenous communities in the curriculum delivery during the teaching and learning process. This will also address the attitudinal gaps due to socio-economic inequalities and bring changes in the outlook for all kinds of skills and works with dignity.

I am highly thankful to *Professor* Dinesh Prasad Saklani, *Director,* NCERT for guidance, motivation and support provided by him throughout the programme and development of this book. The administrative support provided by *Professor* Sridhar Srivastava, *Joint Director*, NCERT is gratefully acknowledged.

The book will definitely help to spread awareness about saving precious heritage of indigenous knowledge of wild plants and vegetables and also to develop a vision and conceptualise a curricular framework to integrate the indigenous knowledge of wild plants and vegetables in the present education system.

Sunita Farkya
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ACKNOWLEDGMENTS

The National Council of Educational Research and Training (NCERT) acknowledges the valuable contribution of the individuals and organisations involved in 'The National Interactive Meet on Wild Vegetables and Fruits and their Conservation' and the development of this book. The Council acknowledges the valuable inputs of Dinesh Kulkarni, *Secretary*, Bharatiya Kisan Sangh; Anupam Mishra, *Vice Chancellor*, Central Agricultural University, Imphal, Manipur, India; Gajanan Dange, *President* and Kapil Ramesh Sahasrabuddhe, *Senior Vice President,* YOJAK Centre for Research and Strategic Planning for Sustainable Development, Mumbai, Maharashtra and Ashutosh Murkute, *Director*, Mahatma Gandhi Institute of Rural Industrialisation, Vardha, Maharashtra. Acknowledgments are due to Sanjay Patil, *Senior Thematic Programme Executive*, BAIF Development Research Foundation, Nasik, Maharashtra for identification of some wild vegetables and fruits, and Priyanka Varshney, *Assistant Professor*, Lady Irwin College, Delhi University for her contribution in initial review process of all articles and research papers.

The administrative and technical support provided by A. P. Behera, *Joint Director*, CIET and his team is sincerely acknowledged. The Council acknowledges the administrative support provided by Ashita Ravindran, Former *Head,* PMD and Dinesh Kumar, *Head,* PMD for organising the National Interactive Meet 2022 and 2023.

The efforts of Soumma Chandra, *Editor* (Contractual); C. Thangminlal Doungel, *Assitant Editor* (Contractual); Deepti Garg, *Proof Reader* (Contractual), Publication Division, NCERT; Surender Kumar, *Incharge*, DTP Cell, NCERT; Mohan Singh, *DTP Operator* (Contractual); Gandharv, *DTP Operator* (Freelance); Arun Verma, *DTP Operator*, (Contractual); Poonam, *DTP Operator*, (Contractual); Kunal Rajoria, *Graphic Designer* (Contractual) and Fatma Nasir, *Artist* are highly appreciated.

The administrative contribution of Chandrakala Mohan, *Section Officer*, Manish Siwach, UDC, in Secretariat of DESM; APC office of DESM, and Secretariat of NCERT are also acknowledged.

Contents

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Studies and Exams

Personal Relationships

Career Concerns

Peer Pressure

Seek Support of Counsellors

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1 TEACHING AND LEARNING OF SCIENCE BY HARNESSING TRADITIONAL INDIGENOUS PRACTICES OF TRIBAL COMMUNITIES

Sunita Farkya*

ABSTRACT

Tribal communities have rich indigenous wisdom which they have gained due to their proximity with nature for ages. Nature is the ultimate source of energy to derive all amenities—food, fibre, shelter, sustenance and growth. As a result of their long-term association and everyday conscious and unconscious observations the nature has equipped them with rich practical experiences for their sustenance, and thus they could contribute in devicing an indigenous knowledge system. Different tribal communities have evolved an immensely rich knowledge and infused it with the art, culture, festivals, rituals and more, for sustainable growth and conservation of natural resources. This traditional knowledge is an integral part of their personal, social, cultural and economic identity, and is unique to every culture and community with oral communication. Primary mode of sharing the knowledge from one generation to other in an informal and non-formal educational set-up is important. However, in absence of proper documentation, there is a constant fear of losing this rich traditional knowledge forever. A tribal learner has always been embedded in community practices and has gained experiential learning acquiring certain skills and competencies.

The National Education Policy 2020 (NEP 2020) is taking pride in our own knowledge system. The commitment to go back to our roots and create a future of our own strengths becomes all the more important in context of NEP 2020. It is, therefore, very important to safeguard our intangible cultural heritage and learn

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to connect them with curricular practices, that will also reduce the curriculum load.

This chapter emphasises on the integration of informal and non-formal learning of indigenous practices including art and culture of ethnic communities into formal set-up of school education. It focuses on knowledge of different communities on traditional indigenous practices and their pedagogical implications in teaching of science and for developing competencies in children. It also discusses environmental perspectives of the indigenous practices of forest communities along with few highlights on role and importance of indigenous knowledge system and traditional indigenous practices of ethnic communities on bridging some of the generic gaps while curriculum delivery. There are suggestions and recommendations for teachers, researchers, educationists, curriculum developers and policymakers to visualise and carve out a way for inclusion of more sustainable and inclusive practices. Another important aspect is knowledge sharing with a strong sense of pride and belief in our own logic and evidence-based indigenous knowledge systems and that would be helpful for learning of science concepts. This will help us realise our dream of a healthy, sustainable, self-sustained and progressive society and the nation.

Keywords: *Indigenous Traditional Knowledge, Formal School Curriculum, Science Education, Informal Learning, Non-formal Learning*

INTRODUCTION

Traditional practices of tribal communities have always been a part of non-formal education or informal education, not only in India, but all over the world (Singh, 2013). Both non-formal as well as informal education are *in situ* learning where learners are embedded in the community practices with the community experts. While assisting them, they experience each moment of it and inadvertently learn skills too. They learn under the social milieu with either of the parents or both parents, grandparents, siblings, neighbours, community workers and more, in an informal learning environment, such as farmers for agricultural practices, carpenters for carpentry practices, plumbers for plumbing practices and so on. Under non-formal situations, learners are involved in those practices involuntarily and learn without any stress of learning achievement such as through local game, dance, cultural practices, rituals and social activities. It is an amazing way of learning while performing those practices because these practices provide contextual learning and skills. In this way the knowledge is being transferred from one generation to other (Mandi and Chakravarty, 2020).

In India, there are diverse tribal groups living in harmony with nature even under the most hostile environment (Sargunam, 2017). And, for them nature has become a learning lab since ages. In different geographical locations present in Indian territory, various tribal communities exhibit examples of organic symbiotic relationship with nature. Their long and close proximity with nature has equipped them with rich experiences to devise indigenous knowledge systems about development and conservation of forest ecosystem, farming practices, herbal medicines and much more (Sarma, 2016; Sharma, 2015). This practical, indigenous, first-hand knowledge has also helped them to devise various mechanisms and practices to optimally and judiciously utilise various natural resources and their varied products in diverse and unique ways (Mandi and Chakravarty, 2020). These practices seem truly scientific and provide conceptual understanding in science; for example, winnowing (NCERT, 2005 a and b) for understanding of separation of substances on the basis of gravity and mass (separation of husk from grains), making of *mahua* drink for understanding of fermentation at certain stages of school science curriculum.

Due to their prolonged relationship and continous observations of nature, they have entered the informal research and investigation practices and replicated their practices with modifications over time (Ravishankar and Selvam, 1996; NCERT, 2018). Thus, these ethnic communities have evolved an immensely rich knowledge and infused them with the art, culture, festivals, rituals, social activities and so on, for sustainable growth and conservation of natural resources (UNESCO Education, 2010). This traditional knowledge is an integral part of their personal, social, cultural and economic identity and is unique to every culture and community, with oral communication being the primary mode of sharing the knowledge from one generation to the other (Brouwers, 1993). These ethnic communities have always generated, refined and passed-on the knowledge verbally across the generations along with hands-on experiences. Of course in absence of proper documentation, there is a constant fear of losing this rich traditional knowledge forever.

Fig. 1.1: A tribal woman collecting salt formed on plant branches during salt farming, District Surendra Nagar, Gujarat (Personal observation)

Fig. 1.2: Making of mahua drink in a tribal home, Chhattisgarh (Personal observation)

It is therefore, important, relevant and pertinent to not only revisit, cherish, celebrate and preserve our indigenous knowledge system(s) and practices, but also to visualise and carve out ways and means for more sustainable and inclusive practices and wider knowledge sharing with a strong sense of pride and belief in our own logic and evidence-based indigenous knowledge systems. This will help us realise our dream of a healthy, sustainable, self-sustained and progressive country. The commitment to go back to our roots and create a future of our own strengths becomes all the more important in the context of National Education

Policy 2020. The policy lays strong emphasis on realising the importance of and taking pride in our own knowledge system; and to come out strongly from long etched colonial historical roots in collective Indian psyche (NEP, 2020).

The process of learning is a social enterprise and the same implies for science as well (Vygotsky, 1978). Community participation in the teaching–learning process is a prerequisite to a good science education. In India the idea of community involvement in learning is not new. Community has always been involved in the informal learning through their social practices, rituals or festive events. NEP 2020 has emphasised competency-based learning and skills development. It lays emphasis on community involvement in the teaching and learning process too.

In this chapter, the author has tried to bring into the attention of scientists, educationists, curriculum developers and policymakers about the importance of strengthening informal and non-formal education and integrating it to the formal education system, particularly in relation to science learning. This integration recognises the value of traditional indigenous community practices and seeks to incorporate them into mainstream education and implies on science learning as well. It is strongly suggested that community involvement in teaching and learning of science is important.

THEORETICAL FOUNDATION IN LITERATURE

Traditional indigenous practices of scheduled tribes communities provide informal as well as non-formal learning (Mandi and Chakravarty, 2020; Sarma, 2016; Sharma, 2015). These practices are useful in learning of science. Coexistence of the three channels of learning including informal, non-formal and formal education in India is age-old. Though for better understanding, these terms have been defined in context of Indian traditions, needs, cultures and policies by Naik. According to Naik (1977), without efficient integration of the non-formal learning, formal education cannot be effective for development and social transformation.

As mentioned by J.P. Naik in his work (GoI, 1971), it is desired to combine the diverge cultures of formal, informal and non-formal learning for strengthening of educational reforms in India. It is the need of the hour to intervene the formal school system by inclusion of overhauling traditional forms of non-formal education, and also bring improvement in the quality of informal education for all (Naik, 1977). Better learning opportunities in science may be optimised by utilising overall international educational contemplation (Faure et al., 1972; UIL, 2012) of encouraging integration of non-formal and informal education to formal education as a comprehensive curricular reforms (Naik, 1977).

Informal education refers to the learning that occurs outside the traditional classroom of educational instituition such as through community activities, cultural practices and everyday experiences. Non-formal education, on the other hand, refers to learning that occurs outside the formal school system through community programmes and vocational training and beyond.

NEP 2020 emphasises tribal and local rooted knowledge and indigenous pedagogy in school education. Some of the related excerpts from NEP 2020 are following:

In its para 4.27, it says about inclusion of tribal knowledge:

> “Knowledge of India” will include knowledge from ancient India and its contributions to modern India and its successes and challenges, and a clear sense of India’s future aspirations with regard to education, health, environment, etc. These elements will be incorporated in an accurate and scientific manner throughout the school curriculum wherever relevant; in particular, Indian Knowledge Systems, including tribal knowledge and indigenous and traditional ways of learning, will be covered and included in mathematics, astronomy, philosophy, yoga, architecture, medicine, agriculture, engineering, linguistics, literature, sports, games, as well as in governance, polity, conservation. Specific courses in tribal ethnomedicinal practices, forest management, traditional (organic) crop cultivation, natural farming, etc., will also be made available.

In its para 4.29, it lays emphasis on indigenous pedagogy:

> "All curriculum and pedagogy, from the foundational stage onwards, will be redesigned to be strongly rooted in the Indian and local context and ethos in terms of culture, traditions, heritage, customs, language, philosophy, geography, ancient and contemporary knowledge, societal and scientific needs, indigenous and traditional ways of learning and so on, in order to ensure that education is maximally relatable, relevant, interesting and effective for our students. Stories, arts, games, sports, examples, problems, etc., will be chosen as much as possible to be rooted in the Indian and local geographic context. Ideas, abstractions and creativity will indeed best flourish when learning is thus rooted."

There is very little mention of theoretical frameworks or orientations in the literature regarding learning of science concepts through informal and non-formal indigenous practices of forest, tribal or nomadic communities. Mostly researcher highlights the work of communities related to environmental conservation or herbal medicines and agricultural techniques. The content of the chapter draws attention to various indigenous practices followed by communities providing informal and non-formal education, highlight the practices to be used for optimising learning of science, skills, competencies, values and to instill pride to the Indian knowledge system upon the young generation.

COMMUNITY PRACTICES AND PEDAGOGICAL IMPLICATIONS IN SCIENCE TEACHING

Attempt has been made to collate the existing tribal community practices through personal observation and cited informations. The communities are engaged in various indigenous practices and they not only sustain their own livelihoods but also make valuable contributions to society at large by producing essencial items for food, fibre and shelter. They also contribute using other skills, art and craft for other essentials. While resolving various concerns for leading the life, community persons innately acquired certain skills as per their interest and capabilities. Accordingly, they have become experts in different areas of problem-solving skills such as plumbing, pottery, farming and more. Apart from these they also acquire knowledge related to their surroundings such as weather, vegetation, flora and fauna and applications in nutritional requirements, medical emergencies and sustainable development. Their continuous interactions, experiences and interrelations with the surroundings while searching for livelihood and resolving various issues equipped them with skills for their livelihood pursuits. Some of the important livelihood interests are hunting, fishing and collection of forest products along with shifting cultivation (Purkayastha, 2016).

Gatherers of Forest Produce

Fig. 1.3: Children collecting fruits of Mahua, Baripeda village (Personal observation)

Collection of forest produce is one of their livelihood options (Soren and Naik, 2020; Reddy, 2018; Patidar et al., 2018). While collecting they keep in mind sustainable availability and efficient replenishment of those forest produces. They follow certain rules for conservation and continuous supply of these forest produces. Some of the examples are— harvesting the crop on the basis of certain indicators such as harvesting tubers on the basis of maturity of leaves or colour of leaves, or harvesting of tubers without affecting associated plant species and many more like this. Children get continuous guidance while roaming around with their parents, grandparents or elderly community persons, siblings or peers in the jungle in search of these forest produces, such as wild vegetables and fruits that have high nutritional value and while collecting them they acquire certain skills and learn by first-hand experiences. This is an *in situ* learning of children in a non-formal set-up that began from their childhood. While doing this work with their elders they learn, gain knowledge and develop skills gradually. Thus, involving these community experts in the education system would help school learners to build strong relationships with their environment, develop problem-solving skills which will equip them to tackle day-to-day challenges, and foster important values too.

Sustainable Hunting, Ethics and Biodiversity Conservation

Hunting and trapping animals was another livelihood option in some of the tribes before 'The Wild Life (Protection) Act', 1972. They followed certain traditional rules for hunting, such as people from a particular community with different family name (*gotra*) may be restricted for hunting of a particular animal or bird species; they do not hunt a female bird; they protect eggs of birds religiously and much more.

While roaming around jungle they have become barefoot ecologists. They not only have become experts of identifying diversity of their surroundings but they also gain expertise in identification of eggs of a particular bird species, their breeding time, breeding seasons, chirping sounds of different bird species and more. They also have developed knowledge about interdependency in a crude manner. Besides, they also develop sharpness in the sensory organs such as sharp eyesight, extraordinary hearing sense, smelling the presence of a particular animal from great distances. This indicates their acute perseverance in acoustic and olfactory body functions. They determine time by observing their own shadow in sunlight. They identify seasons by sounds of insects and birds. By leading life in the close vicinity of nature they get indications from nature and predict seasons. They are well-aware about the plants species they traditionally use as medicines for different ailments.

Case Study

Himmatrao Kanjra Pawar, an elderly person from *Phase Pardhi* community, mimics the sound of a variety of birds. In his own words, “All *Phase Pardhis* have specific skill to mimic the sound of birds for birds call.” So, they utilise their skills to create special sound of female birds and invite male birds. Himmat has knowledge about the diversity of birds around his village in district Akola in Maharashtra.

Fig. 1.4: Himmatrao Kanjra Pawar performing bird’s call, Akola in Maharashtra Courtsey: Shri Kaustubh Ashok Pandharipande, Director, Foundation for Economic and Ecological Development

This traditional skill of mimicking the sound of birds is now becoming vulnerable and vanishing very fast. Because of fast changing culture and pseudo modernisation, youth in the community do not want to learn this traditional skill without thinking of its hindsight utilising it for biodiversity conservation. The skills and knowledge of *Pardhis* are precious which can be used for protection of bird species and also other aspects of biodiversity conservation, education and research. This traditional skill is the strength of *Pardhis*, a highly knowledgeable community having a crisis for livelihood. The promotion of this traditional skill for biodiversity conservation may help them to live life with dignity.

The services of skilled *Phase Pardhis* with their traditional skills may be utilised for training, research and educational purposes or community involved pedagogy to create awareness on importance of conservation of birds, interdependence and biodiversity.

Mimicking the sound may be useful for learning of visually impaired students about diversity of bird species.

The Pastoralists and Cattle Herders

Many of the tribes in India are pastoralists. Pastoralism is one of the traditional indigenous practices of many of the tribal communities, for example, *Toda* in Nilgiri, *Gaddi* in

Himachal Pradesh and *Maldhari*, *Rebari* and *Bharwad* in Gujarat and *Banjara* in Rajasthan. They are herders of sheep, cattle, camel, etc. These cattle herders play a vital role in the ecological restoration and sustainable management (Ingty, 2021). During the process of pastoralism, a pastoralist learns and develops observation skills by observing the behaviour of animals they are working with. They come to know about the available vegetations of different places while they migrate in the process of pastoralism from one place to other. They get familiar with flora and fauna in detail while observing the animals' eating habits in a particular landscape they moved in. They observe their animals, if some of them are pregnant or mother, or have any ailment which is being controlled by eating a particular plant species are basic learning of a pastoralist. They have learnt self-

Fig. 1.5: Pastoralism in Kutch, Gujarat (Personal observation)

Fig. 1.6: Pastoralism in Didihat, Uttarakhand (Personal observation)

Fig. 1.7: Pastoralism in Chiharo, Chhattisgarh (Courtesy: Purshottam Das Saho, Teacher, UPS, Chiharo, Chattisgarh)

medication by observing behaviour of animals and applied their interpretations for various ailments in humans (Shurkin, 2014; Ray-Mukherjee et al., 2010). On the basis of set indicators, they may predict any pandemic in future while raising these animals. They have even learnt that grazing is important for growth of plants and conservation of biodiversity, and overgrazing or undergrazing affects the development of an ecosystem and the diversity of species.

Accordingly, they manipulate animal behaviour by changing direction of their movement in a particular landscape or by allotment of grazing land or by controlling their desire to eat a particular plant species, and so on (Molnár et al., 2020). This is how they contribute in maintaining biodiversity in a particular landscape. They also maintain the continuous supply of plants species that regenerate through tubers for animals grazing (Biró et al., 2020). This way they are better ecologists having age-old first-hand knowledge.

Intricacy of pastoralism lies in the balance between human and animal populations along with natural resources. It is a traditional form of animal husbandry or raising livestock. Pastoralists feed and instruct their livestock through distinct landscape, and in this act, they adapt to different climatic conditions. This is because pastoralist move with their livestock and work with their experiential knowledge of nature and thus outputs of their experiments in production are higher than inputs. Moreover, their practices are helpful in protecting ecosystem. Interdependency of forests and pastoralism result in maintained and renewed land and soil health and also carbon sequestration (Apfelbum et al., 2022; Barry and Huntsinger, 2021; Becker et al., 2022; Byrnes et al., 2018; Grandin, 2022; Lee-Mader et al., 2014; Menefree et al., 2021; Teague et al., 2016; Teague and Kreuter, 2020). For instance, pastoralists while practicing pastoralism learn that ruminants facilitate the germination of acacia tree seeds in dryland forests by digesting them, allowing water and air through it and weakening the outer seed coating.

Hence, they get better equipped in animal husbandry through this traditional method of pastoralism.

The Folk Experts

Fig. 1.8: Folk dance by tribal women in Jhadolphalasia, Rajasthan (Personal observation)

Folklores have great pedagogic interventions for learning science. It provides a detailed description of the subject in a fun way. In a song the lyrics are weaved in with music or paintings or tribal arts. Folk dance and folk songs are important folklores. One of the instances witnessed by the author while interacting with *Bhil* community was that men and women of the community played folk dance on a folk song in two groups. The lyrics of a folk song as sung by them were as under:

One group sings: *angrej sipai ayo ne mhaka jungle me ti mhaka morda ne lei gayo*

(English constable came and took our peacock from our jungle)

Another group replies: *mhaka jungal ti mhako sher aego ne angrej sipai ka ghoda ne laego*

(Our lion from our jungle will take the horse of that english man)

All of them enjoy singing and dancing and relieve their stress in the evening. This in particular educates them of patriotism as well as protection and values of jungle biodiversity.

In another example, *Konkan* men, women and children celebrated *Deepawali* festival by worshiping cow right from the first day and visits everybody's home in the village by playing drums. While playing on drums they sing song describing all speciality of their farm animals, for example, for 'Cow' in two groups in Konkani language the lyrics of their song were as under (Personal interaction with village chief Mr. Chetram Deochand Pawar, Baripeda, Maharashtra):

Figure 1.9: Rathwa Tribal art of Gujarat (Personal observation)

Kapila Gai.....kapila gai tujhe shing kashe?

(How are your horn cow named kapila?)

Mahadevancha trishul jashe

(It is like trident of Lord Shiva. Knowingly or unknowingly they give this message to the next generation that they need to be saved from cow's horn)

Kapila Gai.....kapila gai tujhe pith kashi?

(How is your back cow named kapila?)

Pandharpur che wat jashi

(It is like road to visit Pandharpur. Here they have taught geography to all that the road towards Pandharpur from their village in Maharashtra is like a hilly terrain)

In such kind of folksong during festive occasion traditionally children learn and describe cow with analogy and entrenched with the values of their own pet and cattle. Since the parents, grandparents, neighbours, friends and all are involved they learn a lot from them unconsciously.

Artisans

A number of tribes are involved in different kinds of crafts like basket making, tool making, spinning, weaving and many other skills. These tribal people either combine these occupations with agriculture or may totally depend upon craft for their livelihood (Kumar et al., 2015). Either way, they have to exchange their products for food articles through market or by establishing exchange relations with some other tribes. The *Kotas* of the Nilgiris have exchange relations with the *Badagas* for agriculture products. The *Birhors* of Bihar make ropes and were nomadic in the past. The population of such groups is small. The members of the group learn the skills of the craft from their forefathers while growing up. The craftwork is done at the family level but raw material may be collected at the community level. For example, the basket makers may go collectively for obtaining bamboos but basket making may be a family enterprise. Many tribes are known for their artistic skills of painting. Figure 1.9 depicts painiting made by Rathwa tribe of Gujarat and Figures 1.10(a) and (b) shows painting and artistic walls inside the hut of mahiwars. They use natural colours in their paintings. Through these paintings they provide some messages and skills to next generations. Paintings and artistic walls inside the hut of mahiwar are also resources of learning.

Fig. 1.10(a): Soil painting on huts of Mahiwars, Gandhinu Gaon in Kutch, Gujarat (Personal observation)

Fig. 1.10(b): Artistic walls inside the huts of Mahiwars, Gandhinu Gaon in Kutch, Gujarat (Personal observation)

Shifting Cultivators

Shifting cultivation is an indigenous farming practice of indigenous people in which a piece of forest land is temporarily been chosen for farming practices (Gupta, 2000; MOEF and GBPIHED, 2009; Peale, 1874; Reddy, 1991; Roy et al., 2012; Seavoy, 1973; Shimray, 2004; Swami, 2018; Thangchungnunga, 1987). It is followed by cutting the native plants and vegetation on it and allowing them to dry. The dried vegetation is burnt and the fertile forest land is now replenished by mixing the ash in soil. This way the soil is being prepared. Thereafter, the soil is prepared for sowing the seeds of desired crop to be cultivated. The piece of land is cultivated for 3 to 4 years until the soil is fertile and then may be abandoned for several years allowing natural vegetation to regrow and develop into forest again. Such cultivation is commonly practised in the tribal regions of North-East India, Chhattisgarh, Maharashtra, Bihar, Odisha and Madhya Pradesh. This practice has decreased considerably due to unavailability of forest land and restriction owing to the forest rules. According to an elderly person of Gond tribe, the process of shifting cultivation helps seeds that require warmth to germinate and propagate easily, thereby more dense forest is developed on the abandoned land.

Fig. 1.11: Shifting cultivation by Mahadev Koli in Sangamner, Maharashtra (Courtesy: Vijay Sambre, Freelance Researcher and Conservation Practitioner Sangamner, Maharashtra

Settled Agriculturists

India has been an agrarian country, and as a society and as a family most of the tribes have developed skills in agriculture beyond gender types (Anburaja and Nandagopalan, 2012; Mandi and Chakravarty, 2020). Each and every member of the family whether a child or an elder learns agricultural skills as a part of informal education on farming practices at home and gets acquainted with those practices inadvertently. The more they practice it, the more exposure to different situations

Fig. 1.12: A tribal woman ploughing field (Courtesy: Purshottam Das Saho, Teacher, UPS) Chihro, Chhattisgarh

and more experience and learning takes place under the domain of various interacting factors as parameters. While practicing they become researchers since they observe, analyse and infer their practices and apply new amendments in their practices for better results. Based on their own observations, they have devised practices and strategies for low-cost natural pest control, grain storage mechanism, enhancing soil fertility and optimising agricultural production with optimum resource utilisation (Narayanasamy, 2006; Gangwar and Ramakrishnan, 1989; NCERT, 2018).

Tribals are pioneering conventional researchers in the field of agriculture and grow only traditional crops, such as paddy, millets, pulses, vegetables, etc. In a way they are contributing in the conservation of gene pool in the form of *desi* varieties of various traditional crops (Ravishankar and Selvam, 1996). They have organic ways of saving their crops not only from insect pests but also from wild animals. *Kaani* tribes of Western Ghats of Kanyakumari in India use sounding tools made up of bamboo to keep animals away from their crop fields (Sargunam, 2017).

CONTRIBUTION OF TRIBAL WOMEN IN SCIENCE EDUCATION IN INFORMAL SET-UP

Tribal women are more skilful due to their involvement in all kinds of works and cultural practices. They are a part of folklores, such as folk songs, folk dances, rituals, arts and many other works such as collection of forest produce and their *in situ* conservation for seeking continuous

Fig. 1.13: A woman from bhill tribal community conserved medicinal plants inside her huts (Personal observation) during visit to Baripeda

supply of those forest produces for livelihood, and also for sustainable development are some of the important areas where women have contributed in informal and non-formal education set-up. Besides, they contribute even in the heavy work, for example, ploughing the field, soil preparation and all other agricultural practices (Sharma and Kaur, 2015; Natarajan and Govind, 2006; Kalyani et al., 2011; Brouwers, 1993). Children at home observe their parents and get acquainted with the skills. While assisting their parents they involve in these practices and get first-hand experience. Plants are a part of their daily life. They conserve plants, such as *Portulaca oleracea, Kalanchoe pinnata* and many more plant species in the periphery of their home and use them for various purposes. They have connected mother nature with religious practices so that conservation of nature will become more effective through these practices without extra efforts. And through indigenous cultural practices all the environmental issues and value systems are addressed inadvertently.

Most of these practices have scientific bases and many have been proven with evidences (Sargunam, 2017). They have indigenous wisdom to treat many life-threatening ailments using wild plants (Behera et al., 2006; Thakur et al., 2014). They have their own unique way to use these medicinal plants either alone or in combination with other herbs. They have a unique knowledge of using these herbs not only in a particular way, but the time when a particular plant part has to be used as medicine for optimum effect. They have practiced not to disclose their wisdom to a common person. In a way they contribute by doing this to conserve those plants to avoid over exploitation or untimely eradication of those plants for vested interest by pharma industries. But at the same time values are ingrained into their practice that they provide these herbs as medicines to those in need.

DEVELOPMENT OF LIFE SKILLS THROUGH INDIGENOUS PRACTICES

Tribal practices are full of life skills. These skills are revealed by them through their art and paintings and other folklores. Each and every tribal practice is nature-oriented, and all resources depicted in the pictures are those inspired by nature. The tribal art painting from Odisha shows how tribes have built a hut on a tree facilitated with bamboo staircase (Fig 1.14). All the members are involved in one work or the other and are living in harmony with nature. Birds, pets, squirrels and different kinds of animals and insects are a part of their life. There is a flour mill made up of stone, pestle and mortar, lady cooking food, swing for small children, forest produce, and also decoration in their hut, etc. This painting itself teaches the tribals skills of painting and at the same time spreads a positive message to the future generation that how living in harmony with nature is important under the domain of environmental education.

Fig. 1.14: Tribal Art Odisha (Personal observation)

Fig. 1.15: Sacred grove of Thakrey tribes at Sangamner, Maharashtra (Personal observation)

CULTURAL BELIEFS AND RITUALS

Tribal communities have weaved-in cultural beliefs and rituals with conservation of forest as one of their indigenous practices. They have a variety of reasons and certain traditional rules under which there is a limited scope for various forest activities. This way they have created a social boundary around the fragmented landscapes as a protective layer and developed sacred groves (Lebbie and Freudenberger 1996; Chandran and Hughes 1997; Malhotra et al., 2007; Sheridan and Nyamweru, 2007).

Fig. 1.16: Salt Farming at Surendra Nagar, Gujarat (Personal observation)

Usually the logic of ecological sustainability is interwoven with the local myths and taboos, legends as well as folk tales, folk dances and annual ceremonies associated with sacred groves. These groves have become crucial wildlife corridors and reservoirs for sustaining many rare, threatened and endangered species (Amitangshu and Ormsby, 2017). They are also useful for soil and water conservation. Fostering these traditions instill scientific values and scientific attitudes that are deeply embedded in this system, supporting the preservation of forests and cultivation of innumerable plant and tree species. Certain unwritten, orally transmitted taboos and rules safeguard these groves. Cutting of trees, hunting animals, and plucking leaves, flowers and fruits are restricted in these areas. The product derived of such sacred groves are a part of religious culture and rituals and distributed among all addressing concerns of equity and equality.

ETHNIC COMMUNITY AS DEEP-ROOTED SCIENTISTS

In context of science education, it is apparent that everybody in the community whether knowingly or unknowingly is doing science. Whether it is making of drink with *mahua,* farming of salt, making iron utensils or agricultural implements using spoilt iron or pottery making from clay, they have gained perfection in their skills by following the process of science learning through observation, making hypotheses experimentation, investigation, analysis, inference. After many hit and trial they have standardised the procedure with precision and resolved many problems. They gained agricultural skills as discussed, patiently working with nature under many interacting parameters after years of investigation. Despite the introduction of modern practices and new varieties of seeds, community conserved *desi* varieties of crops in agriculture and helped maintaining the gene bank for various health purposes (M. Madhu Usha et al., 2018; Blakeney, 2020). They have also conserved medicinal plants whether growing wild in forests or in the vicinity of their surroundings, and used them judiciously as and when required for different ailments.

Fig. 1.17: Gadi Lohar, a nomadic community at Bhopal, M.P. (Personal observation)

EFFECT OF MODERNITY ON INDIGENOUS PRACTICES

Ethnic communities have confidence in nature and ecosystem of their surroundings. They not only believe in sustained replenishment of nature, but it is visible in all their actions. Indigenous knowledge is implicit to a community. It is the unique local knowledge which has emerged due to specific conditions of a particular geographical location and indigenous people who are deeply interacting with that particular ecosystem, and establishing their unique relationship for making the habitat sustainable in a holistic manner (Samal, Dhyani and Dollo, 2010). Before the colonial interference, the forest communities had an unimpeded reciprocal relationship with nature and therefore they always endured with self-contained status. A symphonic relationship which these tribal communities shared with nature using the indigenous knowledge was intertwined by the colonial voracity now became detrimental towards the sustainable development in an ecosystem. For example, use of modern technology for reckless extraction of forest produces and herbal medicines ruined the sustainability and mutual relationship among the life forms and an imbalance has been created in nature.

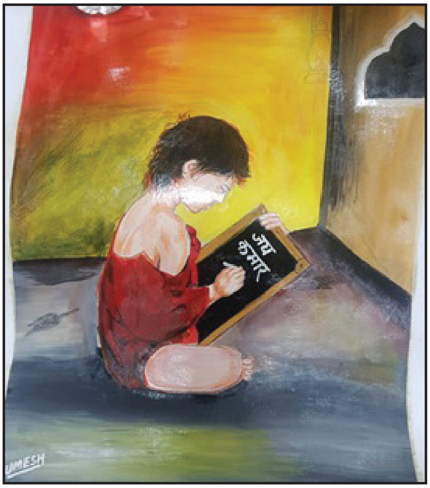

Fig. 1.18: Personal meeting with Tribal Artist, Umesh at Raipur, Chhattisgarh

Owing to certain socioeconomic and political reasons, perception of modernisation has been taken in a developmental senses, which needs to be well-understood and defined that whether the so called modernisation is really a development or not. There are researches that report a deep-rooted tribal life is changing slowly and steadily as a consequence of modernisation and altered lifestyle patterns (Sarma, 2016). As a matter of concern, the youth is not really happy with their indigenous identity (Panipilla et. al., 2017). They are putting their age-old precious indigenous knowledge at stake and many of them have even become wage-labourers.

In a painting, a graduate student named Umesh from a primitive tribal community *kamar* of Chhattisgarh has tried to reveal that there are some areas where the life is not affected due to modernity (Fig. 1.18). While explaining his painting he highlighted that the child has come home after playing with his friends and is trying to do the homework. He is learning to write his name. He is sitting on cow dung flooring near the window for proper light. He doesn't care about his dressing and clothing, but immersed himself in learning with concentration.

In view of the Sustainable Development Goals (SDG) established by United Nations (SDGs; UN 2012b), it is well recognised globally that 'the exploitation of resources belonging to communities living in harmony with nature has reached its limits and that there is a need to restore balance' (Sarma, 2016). Socioeconomic development and global sustainability often contradict with each other due to increasing needs of growing world population versus production and advanced living standards, and managing the effects of production and consumption on the global environment (Griggs et al., 2014). Thus, there is a need to revisit and understand the concept of development and modernity in real sense and come-up with the innovative ideas for conserving the indigenous knowledge of these ethnic communities while promoting sustainable development.

COMMUNITY PRACTICES: AN OPPORTUNITY FOR REDRESSAL OF GAPS IN CURRICULUM DELIVERY

Learner Absenteeism

Learner's continuous absenteeism from school has been observed in many of the rural and tribal areas (NCERT, 2017). The main reasons behind the learner's absenteeism are related to agriculture, i.e., sowing season, cropping seasons, harvesting time, etc. They assist their parents in agriculture. There is a need for involvement of community for curriculum delivery on the related topics in the field for *in situ* learning. Teacher development programme must include teachers' orientation to address the problems of curriculum delivery in such cases and use the opportunity in a positive way for learning of science and agriculture skills. Teachers may identify concepts to be integrated with the tribal practices and create and facilitate learners for competencies and skills development. There are action researches conducted by teachers in this regard to address the issues of absenteeism (NCERT, 2017).

Gender concerns

Despite the fact that most of the tribal communities in India are patriarchal, usually there is no gender desparity seen and in their own world women have a freedom of self-expression. Most of the tribal women work hard side by side with man, or in some instances more than the men. The tribal culture provides women to be empowered by her involvement in all kinds of economic and non-economic practices and opportunities to optimally learn skills and become competent enough for solving different kinds of problems and address them to lead life (Bhasin, 2007). Thus, tribal women are more skilful and competent to be involved in curriculum delivery or in teaching-learning process in related curricular areas, such as agricultural skills, identification of medicinal plants and their conservation practices, local and indigenous knowledge and so on, as a resource person. This will address gender stereotyping and also bridge the gender gaps in young minds in school education. Involvement of tribal women in teaching–learning process either by bringing school children to their work stations for beyond classroom learning pedagogy or bringing tribal women to schools for beyond textbook learning pedagogy, will be a good option to bring back the self-reliance of community women who are skilful and carry a lot of indigenous knowledge with them.

Social disparity

Tribals have developed certain skills and competencies and therefore, their indigenous traditional knowledge is very rich. Learning and working with certain skills will definitely bridge the gap between the rich and the poor (socioeconomic disparity). All the learners may be provided equal opportunities to learn these skills by working with community through different projects. Future generation learners will definitely develop entrepreneurship skills searching for solutions of problems faced by them through *in situ* experiential learning and connecting these practice with science concepts.

Mainstreaming the tribal indigenous practices in science curriculum will definitely bridge the social divide as it will bring back the self-reliance of the communities, which is actually lost due to colonial mindset. The new generation will learn values through valuable indigenous knowledge of tribal community since the tribal culture is full of value education, for example, 'not to waste food' is very much connected to carbon footprint, conservation of biodiversity and environment, and much more.

Fig. 1.19: Students making basket, soup and broom: Learning from tribal resource person (Coutesy: Purshottam Das Saho, Teacher, UPS) Chiro, Chhattisgarh

COMMUNITY PRACTICES: A TOOL FOR INNOVATIVE PEDAGOGY IN SCIENCE TEACHING

Mainstreaming of these vanishing indigenous practices in curriculum is important for their conservation. All the practices address understanding of one to many science concepts to be learnt by the students at school level. Teacher may device various pedagogies based on

Fig. 1.20: Warli Art, Jawhar, Maharashtra (Courtsey: Sanjay Patil, Senior Thematic Programme Executive, BAIF Development Research Foundation)

community practices to facilitate learners and optimise learning. For example, certain concepts of agriculture are integrated with science concepts from Grades VI to XII and may include innovative pedagogy such as field visits, project-based learning, community practices based curriculum and pedagogy, community campaign, meeting/interaction with farmers, and so on. NEP 2020 also recommends ten bagless days for students, learning under informal or non-formal situations, etc., which may miraculously intervene to bring change in rural science education scenario because rural schools may have better learning environment and resources close to nature. Community celebrations, festivities and get-togethers may be an innovative pedagogy for group learning. Author has seen some instances where students learn body movements, which are a part of present curriculum at middle and secondary stages, with the help of the folk dances of tribes of Chhattisgarh which can be performed during festivities and celebrations. Another example is separation techniques, that is, winnowing; to separate husk from grain is due to gravity and difference of mass of husk and grain. Games and sports have been an integral part of tribal culture. Some concepts of Science and mathematics can be taught through games, for example, swing on a big tree to learn the concept of pendulum. Figure 1.20 is revealing a *Warli* painting. The characteristic feature of these paintings is the presence of a number of geometric shapes in it. It is an appropriate teaching–learning material and pedagogy to teach students art integration at an early age of learners. Moreover, *Geru mitti* used for soil painting on walls have various medicinal properties (Kotagasti, 2015).

COMMUNITY PRACTICES AND ENVIRONMENTAL PERSPECTIVES

The sociocultural traditions of tribal communities are full of actions with values and ethics for environmental protection and sustainable livelihood practices. Their sociocultural traditions are in sync with sustainable living and preservation of their surroundings, and have deep and genuine connections with the ecosystems of their habitats. They have an intimate association with the ecosystem they live in, even in hostile conditions like hills, estuaries, coastlines, desert, open ocean and many others. It is noteworthy to understand each and every aspect of the synergistic approaches of the tribals pursuit for sustainable survival and maintenance of all components of nature. All their traditional indigenous practices are in consonance with Sustainable Development Goals (SDG) envisaged and adopted by UN General Assembly in 2015.

Many words in most of the tribal languages have evolved due to their interconnection with the nature and their surroundings and the environmental aspects that are translated through their language in the same spirit. It is important to understand aspects related to the ecosystem in the concerned tribal language. This will help in protecting the biodiversity of the concerned ecosystem as well as local and indigenous languages and vice-versa.

Livelihood practices of different tribes in different areas and ecological locations, demonstrate unique features of that habitat and ecosystems as well as biodiversity of that particular area. For example, the pastoralist communities in the grassland, fishing communities in marine, hunter communities near forest ecosystem and so on. Seasonal variations and biodiversity of a particular habitat allows periodic migration of tribal people from one place to another for their livelihood, revealing their nomadic characteristics. They are all well-aware of biodiversity, extinction of species, or breeding seasons and so forth.

Intervention of modern technology may facilitate work for their livelihood but at the same time they may result in the untimely and overuse of natural resources such as over fishing with modern technology may affect and create imbalance in the marine ecosystem, however, fishing tribes use traditional environment-friendly sustainable fishing methods for the ecology to remain in equilibrium. Therefore, it is very important to mention here that the Forest Rights Act (FRA) was passed in 2006 for Scheduled Tribes and other traditional forest dwellers. The Forest Rights Act (FRA), 2006 provides some of the key rights to individuals of Scheduled Tribes communities. It empowers people who keep up forest areas, and individuals who depend on the forest for their livelihood.

SUGGESTIONS

Here are few suggestions rendered for teachers, teacher educators, educationists, researchers, curriculum developers and policymakers.

Curricular Implications

Content Selections

- Age-appropriate content related to indigenous practices of scheduled tribes community may be infused with appropriate concepts of science. Content may be given as case studies or in the form of assesment as learning, project-based learning, etc.

Pedagogical Inputs

- In the teaching–learning of science in tribal area, teacher must identify indigenous practices and connect them to the concepts of science.
- Outreach programmes or programmes related to science fair, exhibitions of all kinds may be organised with themes on Indian Knowledge System, in which children may be encouraged for innovations in indigenous practices.
- Various pedagogies may be utilised, for example, community survey or awareness campaign for

children's exposure to the community practices and interaction with them.

Teacher Education Programme

- In-service teacher orientation programmes must include sessions on use of indigenous knowledge and practices in teaching and learning process of science.
- Curricular reforms are required for teacher education programme that must include courses on indigenous knowledge as well as indigenous pedagogy of tribal community.

Social Implications

Uplift the confidence of community

- Appropriate strategies may be developed for sensitising community by involving them in each of the activities that will help to achieve cultural competency, encourage participation and reduce social stigma. It must be made sure that all efforts in this connection have to be culturally-appropriate.
- A community resource group for school education may be formed and registered with the state education departments, and time-to-time orientation programmes may be conducted to address the hesitant attitude of community people for sharing indigenous knowledge.
- Connecting sociocultural traditions and livelihood practices with the ecosystem is very important in the teaching-learning process.
- Certain efforts may be made to uplift self-reliance and confidence of the community by realising them about their strengths. For example, preserve and promote the legacy of agriculture in the tribal community.
- Community person may be invited as a resource person in the teaching-learning process (Fig. 1.19).
- Educate the community through outreach efforts or orientation programmes. An orientation and intervention programme for community resource group for interaction with the students will be required.

- Rather than labeling these indigenous communities as backward or underdeveloped, incorporating their rights and know-how and upheaval their confidence in all spheres of knowledge acquisition can have the way towards preserving diverse culture and environments.
- Intellectual property rights of indigenous practices must be given patent.

Community as resource in school education

- It is high time to involve community as a resource in various modes such as inviting them in schools or field visits of students for skill development and community practices, or involving community at the state and national level events organised for children. This will optimise the children-community interaction in the process of learning science, development of skills and competencies, solving problems and in the holistic development of the learners.

Implications for Bridging the Generic Gap

Attitudinal gaps

- Efforts should be carried out to preserve vanishing indigenous knowledge by working together with the community.
- Students may take up summer or winter classes during vacations for gaining indigenous knowledge in non-formal or informal mode of learning. It should be made compulsory.

Language barrier

- It is necessary to integrate tribal language as a source of communication. However, proper integration of tribal languages into the syllabi of concerned States is important.
- An immediate intervention by the interpreter may resolve the language problem, if any, and the teacher capable of understanding the tribal language can help in dissemination of knowledge in an informal way.

Out-of-school children

- Using tribal culture as pedagogy to learn science may be an effective way to stimulate their learning and stay back in schools for long.
- Children may be taught in the field while they are involved in performing indigenous practices of community in nearby area.

Blending Indigenous Knowledge with Modern Science

- Efforts may be made to strengthen informal and non-formal education and their integration with formal educational set-up for learning of science.
- It is suggested to include a course on blending of traditional practices with modern science in teacher education curriculum, to enhance students' interest in learning, and to take pride in their own culture. There are researches that have shown that this strategy has increased interest of students in science learning as well as in linking indigenous practices with science and mathematics (Lee et al., 2012).

LIMITATIONS

- Since it is related to livelihood, there may be some constraints in sharing indigenous knowledge by the tribal community people.
- Topology of the area including geographical limitations such as weather, distance, lack of transportation and communication facilities and isolation may restrict the movement of the community.
- In the present scenario, under formal set-up of school education, many tribal children are out-of-school because they support their family economically by helping them in livelihood practices. However, some of them exhibit seasonal absenteeism because they need to assist their family in certain agricultural practices or other seasonal work.

- Language may be one among the barriers in learning and due to learning gaps, tribal children opt for leaving the school or stay absent continuously from schools.
- Sociocultural and socioeconomic issues arise due to deeply-rooted traditions around food, lack of trust and social beliefs around certain behaviours.
- Demotivated community people due to intoxication or addiction may be a limitation.

CONCLUSION

Since the traditional indigenous practices of Scheduled Tribes communities carry abundant possibilities of interventions in learning of science in school education, hence, it may not only provide an *in-situ* and experiential learning to learners but also better understanding of related science concepts. There is a need to strengthen informal and non-formal education through these community practices. Integration of informal and non-formal education into formal education is the need of the hour for bridging all kinds of gaps and addressing the implementation of science curriculum in school education. Traditional indigenous practices of tribal community and their local knowledge has strong implications in learning science concepts. It is relevant to design pedagogical practices that can provide experiential learning with community. More researches are needed to identify such practices and map them with science concepts for regular teaching–learning process.

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2 ICAR-RESEARCH AND DEVELOPMENT OF WILD VEGETABLES AND MEDICINAL PLANTS

Randhir Singh*

Abstract

The Indian Council of Agricultural Research (ICAR) coordinate, guide, and manage research, education and extension in agriculture including horticultural science, fisheries science, animal sciences and natural resource management in the country. The Council has a large network of institutes, universities and Krishi Vigyan Kendras (KVKs) to address issues related to research and development. The Indian Institute of Vegetable Research (IIVR) has been working on basic, applied and strategic research to increase production, productivity and utilisation of vegetables for livelihood of farmers and nutritional security. The Directorate of Medicinal and Aromatic Plants Research (ICAR-DMAPR) is working on aromatic and medicinal plants. To move forward, we need to document and conserve indigenous knowledge, use wild plants in developing new varieties, develop Good Agricultural Practices (GAPs) and Good Manufacturing Practices (GMPs). There is a need to educate school children at primary level to create interest in issues related to wild vegetables and medicinal plants.

INTRODUCTION

The Indian Council of Agricultural Research (ICAR) was established on 16 July 1929 as an autonomous organisation under the Department of Agricultural Research and Education, Ministry of Agriculture and Farmers Welfare, Government of

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India. The Council is an apex body for coordinating, guiding and managing research, education and extension in agriculture including horticultural science, fisheries science, animal sciences and natural resource management in the country. With a network of 103 ICAR institutes, 11 Agricultural Technology Application Research Institutes (ATARIs), 63 State Agricultural Universities (SAUs), 3 Central Agricultural Universities (CAUs) and 731 Krishi Vigyan Kendras (KVKs) spread across the country, the Council provides a unique agricultural system.

The Krishi Vigyan Kendras (KVKs) have a mandate of Technology Assessment and Demonstration for its Application and Capacity Development for farmer-centric growth in agriculture and allied sectors through application of appropriate technologies in specific agro-ecosystem perspective. The major activities of KVKs include on-farm testing to assess the location specificity of agricultural technologies under various farming systems; frontline demonstrations to establish production potential of technologies on the farmers' fields; capacity development of farmers and extension personnel to update their knowledge and skills on modern agricultural technologies; working as Knowledge and Resource Centre of agricultural technologies for supporting initiatives of public, private and voluntary sectors in improving the agricultural economy of the district; and providing farm advisories using ICT and other media means on varied subjects of interest of farmers. In addition, KVKs produce quality technological products (seeds, planting materials, bio-agents, bio-products, livestock and fingerlings) and make it available to farmers, organise frontline extension activities, identify and document selected farm innovations and converge with ongoing schemes and programmes within the mandate of KVKs.

The ICAR has played a pioneering role in ushering Green Revolution and modernisation of agriculture in India through its research, education and extension activities including wild vegetables and medicinal plants. A number of ICAR institutes work in these areas, however, ICAR-Indian Institute of Vegetables Research, Varanasi and ICAR-Directorate of Medicinal and Aromatic Plants Research, Anand, Gujarat are specifically working in these areas (www.icar.gov.in).

ICAR MANDATE

- Plan, undertake, coordinate and promote research and technology development for sustainable agriculture.
- Aid, impart and coordinate agricultural education to enable quality human resource development.
- Frontline extension for technology application, adoption, knowledge management and capacity development for agri-based rural development.
- Policy, cooperation and consultancy in agricultural research, education and extension.

ICAR-INDIAN INSTITUTE OF VEGETABLE RESEARCH, VARANASI

India has a rich heritage of several indigenous horticultural crops, widely distributed throughout the country. Horticulture germplasm constitutes important natural resources and can play a vital role in the sustainable development of horticulture. A wide genetic base is essential for the development of new genotypes capable of surviving under heterogeneous environment with excellent plant performance. The indigenous horticultural crops can be instrumental to mitigate the issues of nutritional security, as these germplasms are sources of unexplored phyto-nutrients and have potential health benefit attributes. The indigenous horticultural crops also have scope in many afforestation programmes for plantation in degraded and problematic soil. These crop species have tremendous potential for livelihood improvement of smallholder and women farmers.

In order to increase production, productivity and utilisation of vegetables for livelihood and nutritional security of the country, ICAR-Indian Institute of Vegetable Research has made concerted efforts in basic, applied and strategic research for vegetables through mega-programmes.

Wild Vegetables as a source of genetic material in crop improvement programme

Plant genetic resources are the basic materials that are essential for development of improved crop varieties designed to combine high yield potential with superior quality, resistance to diseases and pests, and also better adaptation to abiotic stress environments. Their continued availability to plant breeders is necessary not only for sustaining advances in crop productivity but also for stabilising production. Horticultural germplasm constitutes a broad spectrum of diverse genepools representing assemblage of landraces, primitive cultivars, varieties of traditional agriculture as well as wild and weedy relatives of crop plants. In the last two decades, much attention has been drawn to indigenous local cultivars adapted in particular because of the useful genetic variation they contain as an invaluable resource for present and future plant breeding, and the rapid rate at which they are disappearing due to abandonment, replacement by high-yielding varieties and erosion of their natural habitats. Adequate diversity is not yet been represented in the existing collections at national, regional and international levels.

Livelihood support to smallholder farmers

A large proportion of Indian population derive their livelihood from many indigenous fruits, medicinal and forest species. In many places where primitive farming is practiced, the farmers especially tribal farmers and women farmers continue the traditional norm of farming with the local varieties using limited resources. Generally, these farmers constitute the smallholder farmers and marginal farmers who face immense vulnerability in context of changing climate scenario, economic and policy reforms, post-harvest logistics and market challenges. To overcome such issues, Government of India have come up with protection of plant germplasm and prioritising the locality dwellers as the sole owner of the germplasm through provisions of geographical indications. Additionally, the agri-export zones have also facilitated the export of popular region-specific germplasm and enabled in creation of their niche market at international platforms. With increasing awareness on the immense potential of horticultural germplasm especially in context of nutraceutical and pharmaceutical significance, there exist ample scope for livelihood enhancement of the farming communities who are conserving such germplasm since time immemorial.

Furthermore, the underutilised fruit species such as jamun, aonla and custard apple have the ability to grow under degraded soil condition and hence offer ample scope for adding income enhancement dimensions for small, marginal farmers and women farmers through large-scale plantation combined with community-based approaches, contract farming, agro-industrial linkages, etc.

Future scope to revolutionise nutrition-fortification

The indigenous horticultural species, native and primitive horticultural crops can be designated as 'beauty in disguise' as they have tremendous potential to strengthen nutritional needs and can be a successful part of nutri-farms, nutrition gardens in rural and peri-urban areas. Ensuring food security of the enormously growing population is pivotal, but assuring nutritional security is critical. Such native horticultural plant species have tremendous nutritional and health promoting attributes, and have ample scope for utilisation on commercial scale in near future.

Native Horticultural Plant Species Germplasm

Indigenous vegetable species: Global diversity in vegetable crops is estimated at about 400 species, with about 80 species of major and minor vegetables reported to have originated in India.

Annual Indigenous Vegetables	
Leafy vegetables	• *Alternanthera sessilis* • *Amaranthus tricolor, A. dubius and A. tristis* • *Beta vulgaris*: Indian spinach • *Brassica juncea* var. rugosa • *Chenopodium album*: *Bathua* • *Corchorus olitorius:* Nalta Jute or *Pat Sag* • *Enhydra fluctuans*: Water cress • *Eryngium foetidum*: Spiny coriander • *Fagopyrum esculentum* (Buckwheat) and *F. tataricum* (Green buckwheat, kaspat) • *Ipomoea aquatica*: Water spinach • *Leucas aspera*: White dead nettle • *Pouzolzia bennettiana*: Creeper food plant Hindi name: *Bichchhoo* family • *Spilanthes oleracea:* Paracress • *Sauropus androgynus*: Chekkurmanis • *Trigonella foenum-graecum*: Fenugreek
Vegetables (fruits used)	• *Benincasa hispida*: Ash gourd • *Cucumis melo var. agrestis*: *Kachri* • *C. melo var. momordica*: Snap melon (locally known as *Kachra*) • *Luffa cylindrica*: Tender leafy twigs of sponge gourd eaten as vegetable • *Momordica dioica*: Spine gourd • *M. balsamina*: Green fruits of balsam apple are used as vegetable • *M. tuberosa*: Tender green fruits of bitter cucumber

Indigenous Perennial Vegetables	
Leafy vegetables	• *Bacopa monnieri*: The whole plant of water hyssop or Indian brahmi is cooked as a leafy vegetable • *Bambusa spp.*: Young/tender shoots of *B. bamboos* • *Basella sp.*: Basella (Indian spinach, Malabar spinach • *Diplazium esculentum*: Young fronds of *lungru* are eaten • *Gmelina arborea*: Young tender leaves of Malay bush beech are used as vegetable • *Nymphaea spp.*: Water lily whose stem, young leaves, lower buds, flower stalks and rhizomes are used as vegetables • *Paederia foetida*: Leaves of sewervine • *Pisonia grandis (P. alba*): Lettuce tree • *Polygonum sp.*: Green and dried leaves of knotweed • *Urtica sp.*: Nettle
Vegetables (fruits used)	• *Coccinia grandis*: Ivy gourd • *Moringa oleifera*: Drumstick • *Parkia roxburghii*: Tree bean • *Piper mullesua*: *Pahari* pipal • *Sesbania grandiflora*: *Agathi* • *Solanum indicum*: Bush tomato

Tropical indigenous fruit species: India has rich germplasm of following indigenous/underutilised fruit species:

- Jackfruit *(Artocarpus heterophyllus)*
- Bael *(Aegle marmelos)*
- Carambola *(Averrhoa carambola)*
- Elephant apple *(Dillenia indica)*
- Tamarind *(Tamarindus Indica)*

- *Jamun (Syzygium cumini)*
- Custard apple- *Sitaphal (Annona squamosa)*, *Ramphal (Annona reticulata)*, *Lakshman phal*/Soursop *(Annona muricata)*, *Hanuman phal (Annona cherimola)*
- Pineapple *(Ananas comosus)*
- Rose apple *(Syzygium jambos)*
- Watery rose apple *(Syzygium aqueum)*
- Star gooseberry *(Phyllanthus acidus)*
- Wood apple *(Limonia acidissima)*
- *Karonda (Carissa carandas)*
- Bilimbi *(Averrhoa bilimbi)*
- *Chironji (Buchanania lanzan)*
- Hog plum *(Spondias mangifera)*
- *Mahuwa (Madhuca longifolia)*
- *Kendu (Diospyros melanoxylon)*
- *Barhal*/monkey jack *(Artocarpus lacucha)*

CONSERVATION STRATEGIES

The horticultural plant biodiversity is conserved and maintained by several *in situ* and *ex situ* conservation strategies. The constant change in agriculture approaches, deforestation, urbanisation and industrialisation have resulted in gradual erosion of plant genetic diversity from their unique ecosystem especially due to abandonment, inadequate maintenance and climate adversaries. The traditional indigenous knowledge to maintain the indigenous plant species has also decreased in the younger generation influenced by urbanisation. This evokes a concern for constant conservation strategies of such rich heritage by several means.

In situ conservation is the most ideal way of preserving the germplasm in its own natural ecosystem. It also refers to on-farm conservation. *In situ* conservation has been considered as the primary conservation strategy by the Convention on Biological Diversity (CBD) and further, it has been clarified that *ex situ* measures should play a supplementary role to achieve conservation targets.

Some of the extensively used *ex situ* conservation approaches include field gene bank/clonal repository, seed gene bank, *in vitro* gene bank, cryogenebank. (*Source: Annual Reports, ICAR-IIVR, Varanasi*)

ROLE OF ICAR IN MEDICINAL AND AROMATIC PLANTS RESEARCH

India is blessed with a rich heritage of 15,000–20,000 medicinal plant species of which 7,000–7,500 species are being used in Indian System of Medicines. Globally, the medicinal and aromatic plants contribute significantly in drug innovations and healthcare of human and animals. A small population (8%) rely on traditional plant-based medicines in developing and least developed countries and provide employment opportunities to rural people particularly forest dwellers, landless and marginal farmers. In India alone, 270 million people depend directly or indirectly on Non-Timber Forest Produce (NTFPs), including Medicinal and Aromatic Plants (MAPs), for their livelihoods. The growing demand for herbal-based products help in strengthening rural economies and improving livelihoods.

About 8,000 herbal remedies have been codified in AYUSH systems in INDIA. Ayurveda, Unani, Siddha and Folk (tribal) medicines are the major systems of indigenous medicines. More than 3000 years old system of Ayurveda medicines have widespread acceptance. Ayurveda, Siddha and Unani systems of medicine have more than 90 per cent formulations which are plant-based. In modern medicines, natural products are used as medicines and 80 per cent modern medicines are derived from plants. WHO (World Health Organisation) estimated that 80 per cent of people worldwide rely on herbal medicines for some aspect of their primary health care needs and around 21,000 plant species have the potential for being used as medicinal plants in the world.

India is emerging as a major player in the global trade of plant-based medicines with estimated export of herbal products from India worth US$ 539.87 million in the Financial Year (FY) 2021.

The ICAR-Directorate of Medicinal and Aromatic Plants Research (ICAR-DMAPR) with its outreach programme of All India Coordinated Research Project on Medicinal and Aromatic Plants and Betelvine (AICRP-MAP&B) is marching towards the targeted goal of 'Health for all' to address the ever-increasing world population by ensuring quality raw drug production and supply through planning, coordinating, implementing and monitoring of research and development programmes. This is being achieved through the development of new varieties, good agricultural practices and quality assessment methodologies using frontier cutting-age technologies.

RESEARCH AND DEVELOPMENT OF DIRECTORATE OF MEDICINAL AND AROMATIC PLANTS RESEARCH (DMAPR)

- Conservation of natural habitats and RET (rare, threatened and endangered) species and their sustainable utilisation for maintaining ecological balance.
- Breeding for high yielding, pests and disease tolerant superior varieties with improved quality profile using conventional as well as biotechnological approaches (marker assisted selection, DNA finger printing, barcoding, sequencing, etc.).
- Standardisation of mass multiplication techniques for the production of quality seed and planting material using frontier technologies.
- Understanding of biosynthetic pathway for manipulating secondary metabolites production.
- Standardisation of protocols for *in vitro* production of secondary metabolites.

- Basic and applied research for developing good agricultural and collection practices (GACP) taking into account the agro-climatic suitability.
- Area expansion in MAP through crop diversification and cultivation on problematic, degraded and waste lands for sustainable development and to minimise the cost of production and risk factors.
- Standardisation of post-harvest technologies and value addition to improve quality and minimise the loss of bioactive compounds.
- Implementation of Good Agricultural Practices (GAP), organic cultivation, Good Clinical Practices (GCP), Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP) guidelines for the certification.
- Mechanisation of cultivation and post-harvest operations to improve quality, inputs efficiency and energy use.
- Non-destructive analysis of quality using rapid FT-NIR method.
- Development of management strategies against pest and diseases under changing climatic conditions.
- Standardisation of state-of-art technologies for extraction, characterisation and isolation of essential bioactive compounds and innovative formulations.
- Fixing of permissible limits and development of protocols for the assessment and monitoring of contaminants and residues in raw drugs.
- Development of bioactive natural drugs for challenging diseases like cholesterol, alzheimer's, parkinson's, diabetes, cancers, HIV, etc.
- Application of smart technologies for nutrient and drugs delivery to targeted sites.
- Development of forecasting systems for disease and pest, and other information on area, production and trade.
- Use of information and communication technologies (ICT) for argo-ecological information and species

mapping, and technology dissemination to different stakeholders (*Source: ICAR-DMAPR Vision 2050*).

Edible and medicinal plants can provide healthy alternatives to highly processed foods and pharmaceuticals.

WAY FORWARD

- Traditional knowledge of wild foods is largely transmitted through participation of individuals.
- Documentation and conservation of indigenous knowledge involving local communities.
- Uses are based on observation and ethnomedicinal knowledge.
- Scientific studies of all these herbal drugs are highly desirable to establish their efficacy for safe use.
- Learn basic plant identification skills, proper collection and preparation methods.
- Use wild plants in developing new varieties for bio-fortification, biotic and abiotic stress.
- Promote cultivation in home gardens.
- Prioritisation of *in situ* conservation strategies over *ex situ* approaches should be primarily targeted.
- Accelerate efforts to conserve species and habitats of medicinal and aromatic plants, and development of technologies from production to finished products for sustainable supply of quality raw drugs. Integrated conservation strategies are desired for successful maintenance of the native genotypes. Community-based conservation approaches should be strengthened and supported.
- Develop Good Agricultural Practices (GAP), Good Manufacturing Practices (GMP), testing of heavy metals and impurities.
- Framing of regulatory standards and traceability of products from source to supply through supply chain management, use of non-destructive techniques and barcoding.

- Isolation and extraction of pure bioactive molecules for standard products and development of smart delivery systems with enhanced bioavailability.
- Implementation of Good Agricultural and Collection Practices (GACP) and certification of GACP.
- Location specific, species-wise protocol for production and processing technologies and dissemination involving government and non-government organisations.
- Educate school children at primary level by establishing crop cafeteria in schools.
- National level data repository of documentation and validation of wild vegetables and medicinal plants.

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3 UNDERUTILISED VEGETABLES IN INDIA AND THEIR ROLE IN HUMAN NUTRITION

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Abstract

The use of underutilised or minor vegetables has been gaining attention in recent years due to their potential health benefits and sustainability advantages. These vegetables, which are often overlooked or undervalued, offer a diverse range of nutrients and bioactive compounds that can contribute to a healthy diet and reduce the risk of chronic diseases. Examples of underutilised vegetables includes amaranth, spine gourd, little gourd, ivy gourd, ker, lasoda, snap melon and various types of green leafy vegetables.

Studies have shown that these vegetables are rich in dietary fibre, vitamins, minerals and antioxidants, and can help improve digestive health, lower blood pressure and reduce inflammation. They are also often more resilient to pests and climate change than traditional crops, making them an attractive option for sustainable vegetable farming.

Despite their potential benefits, underutilised vegetables face challenges in terms of production, marketing and consumer acceptance. Lack of awareness, limited availability and unfamiliarity with cooking methods are some of the barriers that need to be addressed to promote their wider use and consumption.

In conclusion, underutilised or minor vegetables have a significant role to play in promoting human health and sustainable agriculture. More research and investment are needed to explore their full potential and develop strategies to increase their availability and utilisation in the food system.

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INTRODUCTION

Cereal-based diets of the people in developing countries are qualitatively deficient in micronutrients, vitamins and minerals due to low intake of vegetables, fruits, legumes and foods of animal origin. India is presently producing more than 191.0 million metric tonnes of vegetables annually from an area of 10.31 million hectares. The area and production is mostly covered by major vegetables but some contribution is also made by several underutilised/minor vegetables which are being grown in different regions and seasons in India. Underutilised or minor vegetables are becoming more popular to address malnutrition, poverty and economic prosperity. These vegetables constitute essential biological assets for the farmers and can contribute in improving the well-being of large tribal population in different parts of India.

Fig. 3.1: Ker Capparis decidua (Tree)

Fig. 3.2: Ker Capparis decidua (Fruit)

Underutilised vegetables are rich in vitamins, minerals and other health promoting factors including high-level antioxidant activity. They can play a major role in the diversification of the diet leading to more rich and balanced source of micronutrients. Furthermore, underutilised vegetables possess resistance to several biotic and abiotic stresses, and can also provide nutrition to the poor masses by meeting the nutrient requirements of vulnerable groups too. A number of underutilised or minor vegetables are natural and rich source of vitamins, minerals and antioxidants. They have potential to contribute to poverty elimination through employment opportunities and income generation and also through improved efficiency and profitability of farm household labour use in both rural and urban environments.

With the use of underutilised vegetable crops, there is a way to reduce the risk of over-reliance on very limited number of major vegetable crops. They add nutrients to the diet and are sometimes convenient food for low income urban people in India. They are adapted to fragile environments and can contribute to the stability of agro ecosystems, particularly in the arid, semi-arid lands, mountains, steppes and tropical forests. They provide a broad spectrum of crops to improve productivity and global food security and to meet new market demands. Several neglected and underutilised vegetables are nutritionally rich and are adapted to low-input agriculture. The erosion of these species, whether wild, managed or cultivated, can have immediate consequences on the food security and well-being of the poor. Their enhanced use can bring about better nutrition. For example, many underutilised vegetables contain more vitamin C and vitamin A than widely available commercial species and varieties. Focusing attention on neglected and underutilised vegetables is an effective way to help maintain a diverse and healthy diet and to combat micronutrient deficiencies, the so-called 'hidden hunger', and other dietary deficiencies particularly among the rural poor and the more vulnerable social groups in India and other developing countries. The growing demand from consumers in developed and developing countries for diversity and novelty in foods is creating new market niches for neglected and underutilised vegetables. These market opportunities can generate additional income for poor farmers in less-favored environments, where these crops have comparative advantages over major staple or commercial crops. In addition, the ability of modern technologies to transform crops and other plants into diverse products and to extend their shelf-life has also created new opportunities to develop

Fig. 3.3: Ivy gourd (Coccinia grandis)

new uses and thus to market these species and their products. Climate change and the degradation of land and water resources have led to a growing interest in crops and species that are adapted to harsh environments such as desert/drought, those with poor soil or degraded vegetation. Cultural biodiversity and use of plants has long been an intimate part of local cultures and traditions. Many minor and underutilised vegetables can play a role in keeping alive cultural diversity associated with food habits, health practices, religious rituals, social exchange and in improving the economic status.

MAJOR UNDERUTILISED VEGETABLE CROPS GROWN IN DIFFERENT PARTS OF INDIA

1. ***Kachri* (*Cucumis callosus*):** It is a drought and high temperature tolerant underutilised vegetable crop; it belongs to cucurbitaceae family. Fruits are small, egg-shaped, weighing 50–60g. Fruits are ready for picking in 68–70 days after sowing of the crop. It is rich in vitamin C (29.81 mg/100 gram), iron, zinc, manganese, copper, fibre, carbohydrates (7.45%) and proteins (0.28%). In the past, it was widely grown in kharif season in Haryana, Rajasthan, Gujarat and other states, but now improved varieties have been developed by Central Institute of Arid Horticulture (CIAH), Bikaner. Nowadays this is being grown as a commercial crop in Bikaner, Nagaur and Jodhpur districts of Rajasthan. Some of the improved varieties developed by CIAH, Bikaner are AHK-119, AHK-200. The average yield of the Kachri crop is 90–10 quintal/hectare with good management of the crop. This crop gives very good economic returns to the farmers as this has replaced *Aamchoor* in the spice industry.

2. **Snap melon (*Cucumis melo var. momordica*):** It also belongs to cucurbitaceae family; and in the past was widely grown in kharif season alongwith the crop of Bajra, Jawar, Maize, etc. Its immature fruits are used as salad, vegetables and in other culinary preparations.

Its mature fruits are generally less sweet as compared to muskmelon; hence it is much liked by the people who are suffering from sugar related disorders. Nowadays, this crop is commonly grown as rainfed crop in the state of Rajasthan and Gujarat, and improved varieties like AHK-10 and AHK-82 have been developed by CIAH, Bikaner. Fruits of snap melon are rich in vitamin A, minerals, carbohydrates, etc. Fruits are ready for harvest in 67–70 days after sowing of the crop. Normally each vine bears 4–5 fruits and the flesh in light pink and the TSS in 4.5–5.0. The average weight of the fruit is 700–800 gram and the average yield of the crop is 240–250 q/ha with good management.

3. **Ker (*Capparis decidua*):** This shrub belongs to capparaceae family. It has many medicinal properties. It is a perennial, densely branched, thorny shrub or tree best adopted to arid conditions. Its immature fruits are used for making pickle, whereas dried fruits are used to prepare 'Punchkuta', a delicious vegetable. It is also used as a carminative, tonic, aphrodisiac, alexipharmic; it improves appetite and is good for rheumatism, lumbago, cough, asthma, diabetes, hypertension and various stomach problems. The fruits are astringent and are useful in cardiac troubles. In the past this was widely grown in western parts of Haryana, several parts of Rajasthan and Gujarat, but presently this minor vegetable shrub is surviving in districts like Jodhpur, Barmer, Jaisalmer, Jalore, etc. It usually flowers two times in a year and fruits in months of April-May and Oct-November. Limited research work has been done on this crop for development of varieties and efficient propagation methods but looking into its medicinal properties and demand has increased not only in domestic markets but in export also.

4. **Spine Gourd (*Momordica dioica*):** Spine gourd (*Kartoli*) is dioecious and perennial climbing cucurbit plant, its spiny fruits are used as vegetable, which are entirely free from bitterness. Fruits are small, dark

green, round or oval shape with spines. Spine gourd fruits are good source of protein (3.1g/1mg), iron (4.69g/100g) and phytonutrients. Its fruits, leaves and roots are used to cure diabetes. The fruits of this widely grown vine plant are mostly available in rainy season to September month. Limited research work has been done on this crop but now looking at its medicinal properties and acceptance, demand in domestic markets and export, research work for development of varieties and production technology has began by some research institutions. Through improved production technology its period of cultivation can be extended and prepounded. Similarly, its fruits can be dried and packed during the major production period by using high tunnels or walking in tunnels.

Fig. 3.4: Spine Gourd (Momordica dioica)

5. **Wild Brinjal *(Solanum torvum)*:** It is a bushy, erect and spiny perennial plant used horticulturally as a rootstock for eggplant. It is called as 'Khamka Shikam' in *Kokborok*. The plant is usually 2–3 m in height and 2 cm in basal diameter but may reach to 5 m in height and 8 cm in basal diameter. The shrub usually has a single stem at ground level, but it may branch on the lower stem. The immature fruits and flowers are used for making the delicious local dish called '*Gwdok*'. The plant is sedative and diuretic, and its leaves are used as haemostatic. A decoction of this fruit is given for cough ailments and is considered to be useful in cases of liver and spleen enlargement (Kala, 2005). The fruits are rich in iron, manganese, calcium, copper, and zinc. The high iron content of the fruit proves the fact that the fruits truly have hematinic property.

6. **Sword Bean (*Canavalia gladiata*):** It is usually called as sword bean and is a plant species of the legume family. It is called as '*Baikang*' in *Kokborok*. The plant is vigorous, deep-rooted and annual to perennial climbing. The stems, which are often slightly woody, can grow up to 10 metres long, scrambling over the ground or twining into other plants for support. The young seedpods are consumed raw or more commonly cooked and used as a vegetable. The seeds contain more crude protein, crude lipid and minerals like sodium, potassium, calcium, magnesium, phosphorus, iron and manganese. Sword bean has many ethnomedicinal properties and it is a source of urease, a useful compound for urea blood analysis in humans.

7. **Drumstick (*Moringa oleifera*):** It is a versatile crop that can be grown as an annual or perennial vegetable. It belongs to the family Moringaceae. In Tripura, every part of drumstick is used as vegetable. However, the tender pods are an excellent vegetable and most preferred. Tender leaves and pods have a high amount of protein, carbohydrates, vitamin A, vitamin C and minerals. Besides it has many medicinal properties also. The leaves of the *Moringa oleifera* have been reported to demonstrate antioxidant activity due to its high amount of polyphenols. Nowadays this is being grown as a commercial crop for fresh produce as well as the dried leaves looking to its demand in the market.

8. **Tree Bean (*Parkia roxburghii*):** It is one of the most common multipurpose tree species of mimosaceae family in the northeastern region of India, especially in Manipur and Mizoram. Locally called '*Wakre*' in Tripura, 'Yongchak' in Manipur and 'Yontak' in Assam. Tree bean is a much-branched legume of medium height (10–12 m) with bipinnate leaves. The fruits in the early stages are soft, tender and bright green in colour. They turn blackish when fully mature in March-April. Pods are formed in clusters of 10–15, each measuring 25–40 cm in length and 2–4 cm in breadth (Kumar et al., 2012).

The tender and matured beans have high demand in the market and are used in various dishes.

9. **Water Spinach (*Ipomea aquatica)*:** It is a semi-aquatic, fast growing tropical plant grown as a vegetable for its tender shoots and leaves. It belongs to the family Convolvulaceae. It is found throughout the tropical and subtropical regions of the world. This plant is known as water spinach, river spinach, water morning glory, water convolvulus and it is known as '*Twi ni lot*' in *Kokborok*. It flourishes naturally in waterways and requires little care. The greens are rich source of vitamins, minerals, proteins, fibres, carotene and flavonoids with many health benefits (Prasad et al., 2008). The leaves also have energy value of 300.94 ± 5.31 kcal/100 g.

10. **Geli-geli (*Lasia spinosa* L.):** It is an evergreen, herbaceous perennial plant of Araceae family growing 1–2 metres tall, spreading by means of a long, creeping and stoloniferous stem. Small prominent spines are found in the stem. In Tripura, it is known as '*Pachok Kwlwi*' or '*Gantha*'. Young leaves and petioles are cooked and used as a vegetable. The leaves and roots are used as a remedy for piles. The plant possesses the major pharmacological activities including anti-helminthic, anti-bacterial, anti-inflammatory, anti-oxidant, anti-diabetic, anti-hyperlipidemic, anti-tumor and various other disease preventive factors. Beans, after scraping the skin, are sliced into pieces for making traditional dish like '*Mosodeng*' (Chutney) preparation. The tree is also of immense use in local medicines. A decoction of bark, fruit skin and leaf is used to control diarrhea and dysentery.

Major Challenges for the Cultivation of Underutilised Vegetable Crops

- Limited awareness among the farming community about the nutritional and medicinal value of underutilised vegetable crops.
- Lack of research, mainly in the area of conservation of genetic resources, development of varieties and production technology for these vegetables.

- Non availability seeds of developed varieties and good planting material.
- Limited application of advance on-farm agro techniques for their cultivation.
- Limited application of improved varieties such as mechanisation, plasticulture for enhancement of productivity and value addition.
- Inadequate marketing supports and infrastructure facilities for transportation, storage and processing.
- Poor recognition of these crops in horticulture promotion programmes in different states and at national level.

Strategies for the Development of Underutilised Vegetable Crops

Domestication of potential wild species through homestead cultivation should be encouraged for avoiding over exploitation from natural sources. Support is required in terms of multiplication of planting materials and their distribution besides providing market access through marketing network for perishables. Underutilised vegetable crops are nutritionally rich and adapted to low input horticulture. More R&D efforts for these crops will add substantially to food security and nutrition vis-à-vis human welfare. Limited number of species need to be targeted for detailed research and development in underutilised vegetable crops by national programmes focusing on their conservation and use. Research needs to be geared up for both on species and crops important for subsistence farming and those exhibiting potential to become commodity crops. Underutilised vegetable crops are mainly grown under traditional farming systems by diverse ethnic communities.

Increased focus to document indigenous knowledge urgently is required such as through ethobotanical studies. Such emphasis will help to tap value additions as much of native diversity is put to multipurpose uses. Strategies need to be worked out particularly at national and regional levels to develop and make available promising varieties, overcoming constraints of production of good seed material, planting material, etc. This would certainly boost production, meeting local needs, promoting domestic markets and thereby, enhance income generation of small farming communities. Some criteria needs to be developed for commercial exploitation of underutilised vegetable crops. The criteria may be high productivity, market demand, freedom from serious insects, pests and diseases, easier postharvest management, high nutritive value and availability of production. There is need for development of good agricultural practices for different underutilised vegetables and development of machines for harvesting of leaves in case of moringa, drying of moringa leaves and fruits in kachri, etc., for reduction in cost of cultivation and production of good quality hygienic produce for niche domestic market and export.

CONCLUSION

Underutilised vegetables embedded with rich nutrient potentials along with the ability to stand adverse climatic conditions may prove a boon to vegetable growers, consumers and environmentalists, provided that they are tamed properly and timely. The possible reasons for the limited cultivation of underutilised vegetables, in spite of their recognised importance are due to lack of availability of varieties, planting material, lack of awareness on nutritional and medicinal importance, and lack of information on production technology of these crops. In this context, there is an urgent need to take up strong programmes on genetic resources exploration, management, utilisation and improvement of underutilised vegetable crops to ensure food and nutritional security for future. Underutilised vegetables can also play an important role in the national economy. The climate and soil of India in different regions are favourable for the production of different underutilised vegetables. Thus, the government of India has been taking some steps towards highlighting the underutilised vegetables. For this, extension agencies can regularly organise special awareness workshops, campaigns, exhibitions, etc., at state and national level conveying the theme of unexploited vegetable crops. Similarly, use of mass media like radio, TV, newspaper and other printed literature can also play an important role in creating awareness among the farmers and consumers.

For proper exploitation and better economic returns from underutilised vegetable crops emphasis should be given on developing processing units only in their production areas, it would also provide employment opportunities to the rural youths. Genetic erosion is very serious problem in underutilised vegetables due to which many land races will become extinct if these are not conserved soon by research institutions like NBPGR or IIVR, etc. Some time efficient production technology and postharvest management practices are necessary to make the commercial cultivation of non-traditional or underutilised vegetable crops for their economic feasibility. The availability of underutilised vegetable crops will go a long way in overcoming the protein, vitamin and mineral malnutrition of the people living mainly in rural and tribal areas of the country. At the very onset, there is a necessity to make the farming community aware about the nutritional importance of underutilised vegetables.

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4 WILD FOODS CONSUMED BY THE ADIVASIS AND OTHER FOREST DWELLERS FROM KALASUBAI HARISHCHANDRAGAD LANDSCAPE OF NORTHERN SAHYADRI (WESTERN GHATS) MAHARASHTRA

Vijay Sambare*, Sayaji Asawale and Budhaji Wale****

"Eat, v.i. To perform successively and successfully the function of mastication, humectant, and deglutition"

(Bierce, The Enlarged Devil's Dictionary)

ABSTRACT

Common wild vegetables and fruits utilised by various tribes of northern sahyadri (western ghats) of Maharashtra were explored and identified. Thirty one plant species were documented with their local names, scientific names, parts used and their preparation for their utility as food. The values of these wild edibles was appreciated by the tribal communities for various ailments.

INTRODUCTION

Since time immemorial, useful plants have been utilised by human societies for medicinal and food purposes. The tribal communities including hunters, forest gatherers, pastoralists, or shifting or settled agriculturists and so on, still continue to have wild vegetables and plants in their daily use. Wild edible plants have sustained human populations in all the inhabited forest continents.

The Western Ghats means Sahyadri, a key biodiversity hotspot in Maharashtra covers an area of 52,000 sq.km.

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** *Community Representatives*

Ahmednagar district is one of the ten districts of Western Ghats region. This district covers an area of 17,035 sq. km and lies between 73º9' to 75º5' E and 18º2' to 19º9' N. The area of Akole *tehsil* in the district Ahmednagar that runs parallel to the western coast is known as Sahyadris. Forest is of moist deciduous type including some evergreen patches. The *Adivasi* population in the *tehsil* is relatively large. Major tribes residing in this area are Mahadev-koli, Thakars, Katkari and other forest dwellers. They speak dialects of the Marathi language. Their major occupation is agriculture. Rice, bean and mountain millets are some of the important crops they cultivate and utilise.

The forest resources play an important role in the livelihood of these communities (Jadhav et al, 2015). Significant work on the field of ethnobotany has been done in past years in the study area. Although much has been documented on the ethnomedicinal and floristic aspects of plants in the district of Ahmednagar, however, there is not even a single concrete report about the wild edible plant resources of Akole tehsil. Keeping this in view, the present documentation was conducted to explore and identify the wild edible plant resources, and to record the indigenous traditional knowledge of these tribal communities about the utilisation of wild edible plants including vegetables and fruits.

METHODOLOGY

The information was gathered by focused group discussion and individual interviews with community people. Information gathered was then validated by spending one year with the community people as daily routine workers by following community practices.

RESULTS AND DISCUSSION

Utilisation and Preparation of Wild Plants

The plant parts including roots, tubers, leaves, flowers, fruits and sometimes whole plant is used as food or food supplements. Herbs constitute highest preparation of the edible species followed by trees, shrubs and climbers in descending order. The time and frequency of harvesting the product varies from plant to plant and species depending upon the availability of edible plant or part which in turn vary from place to place. The edible plant species can be consumed in many ways. Method of preparation and uses fall under different categories such as using them raw, after boiling, after baking, etc. Table 4.1 shows the parts of the plants used and preparations of some common wild edibles used by tribals of western ghats.

Table 4.1: Wild Edibles Used by Tribes of Northern Sahyadri

S. No.	Local name	Botanical name	Parts used	Preparations
1.	Badada	*Arisaema murrayi*	Tuber	Boiled tubers are eaten also as raw.
2.	Shid	*Bauhinia racemosa* Lam.	Flower, leaf	Flowers and leaves are cooked as vegetables.
3.	Kate-saver	*Bomax ceiba* L.	Flower	Flowers, fruits and roots are cooked as vegetables.
4.	Waghati	*Capparis zeylanica* L.	Fruit	Immature fruit is cooked as vegetable.
5.	Shindamakad	*Caralluma adscendens*	Shoots	Shoots are cooked as vegetables, also eaten as raw.
6.	Kurdu	*Celosia argentea* L.	Leaf	Leaves and twigs are cooked as vegetable.
7.	Kolu	*Chlorophytum tuberosum*	Leaf, root	Leaves are cooked as vegetable; also roots eaten as raw.

8.	Alu	*Colocasia esculenta*	Leaf, root	Leaves are cooked as vegetable, also root eaten as raw.
9.	Kadu-kand	*Dioscorea bulbifera L.*	Tuber	Boiled tuber is eaten, also fresh eaten as raw.
10.	Saal Kanda	*Adenia hondala*	Leaves	Leaves are cooked as vegetable
11.	Kaate Math	*Amaranthus spinosus*	Shoot, leaves	Tender shoot and leaves are cooked. Young leaves are dried.
12.	Maath	*Amaranthus viridis*	Shoot, leaves	Young shoots and leaves are cooked as vegetable.
13.	Karavand	*Carissa congesta*	Leaves and fruits	Young leaves and raw fruits are cooked.
14.	Bahava	*Cassia fistula*	Leaves and flowers	Tender leaves and flowers are cooked.
15.	Mor Kharapudi	*Ceropegia oculata*	Tubers and leaves	Tubers are eaten raw and leaves are cooked.
16.	Kharapudi	*Ceropegia bulbosa*	Tubers and leaves	Tubers are eaten raw and leaves are cooked.
17.	Bhokar	*Cordia dichotoma*	Leaves and fruits	Tender leaves are used as vegetable and fruits are eaten raw.
18.	Ambhale	*Elaeagnus conferta*	Fruits	Ripe fruits are eaten raw.
19.	Raan Keli	*Ensete superbum*	Rhizome, inflorescences and fruits	Rhizomes are boiled and eaten, inflorescence cooked as vegetable.

20.	Bhui Umbar	*Ficus hispida*	Leaves and fruits	Tender leaves and young unripe fruits are cooked and ripe fruits are eaten raw.
21.	Umbar	*Ficus racemosa*	Fruits	Unripe green fruits are cooked and eaten. Matured fruits also eaten. Fruits are also dried, floured and consumed with milk.
22.	Tambat	*Flacourtia indica*	Fruits	Ripe fruits are eaten raw.
23.	Kharamatya	*Grewia abutilifoilia*	Fruits	Mature fruits are eaten raw.
24.	Kusar	*Jasminum malabaricum*	Fruits	Mature fruits are eaten raw and cooked.
25.	Ghaneri	*Lantana camara*	Fruits	Ripe fruits are eaten especially by children.
26.	Kavath	*Limonia acidissma*	Fruits	Pulp or ripe fruits are eaten and used in preparation of soft drinks and jam.
27.	Moh	*Madhuca longifolia*	Flowers and fruits	Fleshy corolla is eaten raw and used in sweet preparation. Dried flowers are floured and used for making Bhakari. Flowers are fermented to make liquor. Oil is extracted from seeds.

28.	Aliv	*Meyna laxiflora*	Fruits	Tender fruits are cooked and mature fruits are eaten raw.
29.	Karatule	*Momordica dioica*	Root and fruit	Tuberous roots and young green fruits are cooked as vegetable.
30.	Khaaj kuyari	*Mucuna pruriens*	Leaves and seeds	Leaves and seeds are cooked.
31.	Ambushi	*Oxalis corniculata*	Leaves	Leaves are eaten raw as salad or cooked as vegetable.
32.	Awala	*Phyllanthus emblica*	Fruits	Mature fruits are eaten raw and dried.
33.	Rayawal Amba	*Mangifera indica*	Fruits	Raw and riped fruits are eaten.
34.	Shindi	*Phoenix sylvestris*	Fruits	Mature fruits are eaten raw. Sap is drunk as soft drink (Neera).
35.	Dhol Amba	*Physalis minima*	Leaves and fruits	Leaves are cooked as vegetable and ripe fruits are eaten raw.
36.	Gholu	*Portulaca oleracea*	Shoot	Entire shoot is cooked. Young shoots are consumed as salad.
37.	Rukhalu	*Remusatia vivipara*	Tubers and leaves	Tubers are boiled and leaves are cooked.

38.	Bharangi	*Rotheca serrata*	Leaves and flowers	Tender leaves and flowers are cooked. Before cooking they are boiled for a long time to remove bitterness.
39.	Takala	*Senna tora*	Leaves and seeds	Tender leaves are cooked. Seeds are used in curry and roasted for use as a substitute for coffee.
40.	Kawala	*Smithia hirsuta*	Leaves	Tender leaves are cooked.
41.	Dorali	*Solanum anguivi*	Leaves and fruits	Leaves are cooked and half ripe fruits are employed in preparation of curries and chutney.
42.	Kahandal, Ghuri	*Sterculia urens*	Tender roots, gum and seeds	Tender roots seeds are roasted and Gum is also used.
43.	Jambhul	*Syzygium cumini*	Fruits	Mature fruits are eaten.
44.	Dhayati	*Woodfordia fruticosa*	Flowers	Flowers are sucked for nectar to make cold drinks and are cooked as vegetable.
45.	Toran	*Ziziphus rugosa*	Fruits	Ripe fruits are eaten raw.

CONCLUSION

The wild edibles are consumed by the tribals in the varied forms either as cooked vegetables or raw plant parts (Datar and Upadhye, 2016; Ramnath, 2004). They are also used by them to cure various ailments. However, researches are required to find out bioactive compounds present in these wild edibles and their nutritional as well as medicinal importance in context of the tribal knowledge at large scale. Also, their nutraceutical, pharmaceutical and antioxidant values need to be determined using modern methods.

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5 IMPORTANCE AND HEALTH BENEFITS OF WILD VEGETABLES

Pranita Kadu* and Prabhat Kumar**

ABSTRACT

Wild edible plants are non-domesticated species that grow naturally on farms. Different tribes and rural populations have long used these species as vegetables. As humans began to focus more on domesticating a few species, the popularity of wild species gradually declined. As a result, valuable natural resources are underutilised. This chapter discusses the significance of wild edible plants found in Vidarbha (the eastern region of Maharashtra) in the context of food insecurity and malnutrition. All of the plants discussed here are found in Vidarbha, Maharashtra, in rural and forest areas. The following families contain the majority of the wild vegetables species: Araceae, Amaranthaceae, Basellaceae, Caesalpiniapae, Commelinaceae, Cucurbitaceae, Poaceae, Portulacaceae and Oxalidaceae.

Keywords: *Wild Edible Species, Food Insecurity, Malnutrition*

INTRODUCTION

Vidarbha (Maharashtra's eastern region) has a great biodiversity of plants. It has many plant species that have been used by indigenous tribes for centuries

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due to various health benefits. Several studies have indicated that wild edible plants are a potential source of nourishment and that they are usually more nutrient-dense than commonly consumed crops (Grivetti and Ogle, 2000; Ittyerah, 2013). However, certain wild vegetable species are unknown to us due to a lack of knowledge. Most rural communities depend on the resources which are available in nature, including wild edible plants to meet their food needs in periods of food crises, in addition to added food supplements (Rashid, 2008). Green vegetables are out of reach for many rural families due to their high cost. As a result, the number of people suffering from anemia and osteoporosis is rising in rural India. This issue can be resolved by incorporating wild varieties of vegetables with high nutritional value (calcium, iron and proteins) into our diet. These vegetables grow naturally on farm borders and on the hills of tribal areas during the rainy season. These wild vegetables were once very popular and consumed as delicious dishes. Even today, the older generation feels nostalgic when discussing dishes from their youth. Aside from that, some of these are used in religious ceremonies as part of specific rituals.

WILD VEGETABLES WITH HIGH NUTRITIONAL CONTENTS

The term 'wild vegetables' describes plant species that have not been domesticated, and are present in their natural habitat and are used as vegetables by the local population (Beluhan and Ranogajec, 2011). Numerous researches on these plants demonstrate that they produce vegetables with more nutritional content than those that are frequently grown. *Aghada* (*Achyranthes aspera* L.), *Kena*, *Tarota* (*Colocasia esculenta*), and *Matalu* are vegetables with rich calcium, iron, mineral and vitamin contents. The nicest thing about these wild vegetables is that no chemical pesticides or fertilisers are utilised, so they are free of contamination.

SIGNIFICANCE OF WILD EDIBLE VEGETABLES

Wild species and intra-species biodiversity are important component of global food security. Following are some key features of wild edible vegetables:

- High nutritional value
- Better adaptability to all kind of ecosystem
- Sustainable food
- Free from chemical contamination as they grow naturally.

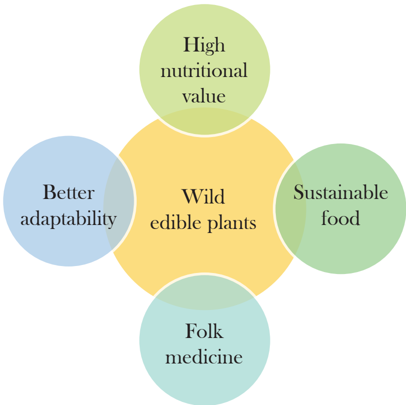

Fig. 5.1: Illustration showing importance of wild edible plants

Underutilisation of Wild Heritage

Vegetables like *tarota* or *takli (Cassia tora)*, *mayalu (Basella alba)*, *flax* (*Linum usitatissimum*), *tandulja* (*Amaranthus spinosus*), *ghol (Portulaca oleracea)*, *chivali (Portulaca quadrifida)* and *pata (Cyclea peltata)* contain high quantities of calcium. They can be used as an alternative to milk in low-income families. Besides these, the leaves of *Vavading* (*Embelia ribes*), *Pol* (*Cocos nucifera*) and *Gulbakshi* (*Mirabilis jalapa*) also contain a high amount of calcium, iron and vitamin A. Unfortunately, these resources are underutilised. Following are some reasons for underutilisation of these wild edible plants:

1. **Lack of Information:** Since indigenous wild vegetables' traditional knowledge is passed down

orally from one generation to the next, there aren't many written sources regarding them. Because of this, these wild plants with high levels of micro and macronutrients are unknown to the urban population.

2. **Inferior Status:** Generally, these vegetables are consumed by local natives and tribes due to their large availability and low cost. People in the urban region associate these vegetables with low status.

3. **Large Scale Utilisation of Cultivated Crops:** Plants that once provided significant flavour and textural enjoyment, and supplied vital nutrients to the diet fell in popularity as people began to place more emphasis on domesticated cultivators and less emphasis on wild species.

4. **Lifestyle Change:** Diets notably changed in two ways when humans transitioned from hunter-gatherers to civilised, technologically advanced and economically secure beings. First, there is a greater reliance on fewer staple cultivated plant foods, and second, the number of wild edible plants that once maintained health and nutrition, reduced and eventually got eliminated (Grivetti, 1978, 1981).

Fig. 5.2: Colocasia esculenta

Fig. 5.3: Rumex vesicarius

Table 5.1: List of wild edible plants used by native and different tribes of Vidarbha region

S. No.	Local name	Botanical name	Family	Habit	Growing season	Edible part
1.	Aghada	*Achyranthes aspera*	Amaranthaceae	Shrub	September to April	Seeds and leaves
2.	Kena	*Commenlina benghalensis*	Commelinaceae	Herb	July to November	Leaves
3.	Tarota	*Cassia tora*	Caesalpiniaceae	Shrub	July to November	Leaves
4.	Chandan batwa	*Atriplex hortensis*	Amaranthaceae	Plant	July to November	Leaves
5.	Kartoli, Rankarli	*Momordica dioica*	Cucurbitaceae	Climber	July to November	Fruits
6.	Tandulja/ Kardu	*Amaranthus blitum*	Amaranthaceae	Shrub	July to November	Leaves
7.	Ghol	*Portulaca oleracea*	Portulacaceae	Shrub	July to November	Leaves
8.	Chivali	*Portulaca quadrifida*	Portulacaceae	Shrub	July to November	Leaves
9.	Bamboo/ Kelta/ Basonbda	*Bambusa arundinacea*	Poaceae	Plant	July to November	Stem
10.	Vavading/ Mayalu	*Basella alba*	Basellaceae	Climber	July to November	Leaves
11.	Pathari	*Launea procumbens*	Asteraceae	Shrub	July to November	Leaves
12.	Gulbakshi	*Mirabilis jalapa L.*	Nyctaginaceae	Plant	August	Leaves
13.	Chamkura/ Pothi/Alu	*Colocasia esculenta*	Araceae	Plant	All seasons	Leaves
14.	Kadvchi	*Cymbalaria*	Cucurbitaceae	Shrub	July to November	Fruits
15.	Aambushi/ Bhuisarpati	*Oxallis corniculata*	Oxalidaceae	Shrub	July to November	Leaves

Fig. 5.4: Cymbalaria

Fig. 5.5: Portulaca oleracea

Fig. 5.6: Launea procumbens

Fig. 5.7: Commenlina benghalensis

CONCLUSION

Wild edible plants have been a staple of human diets since the dawn of time. Despite the fact that the popularity of these wild species has declined, many macro- and micronutrient-dense wild species deserve more attention, but due to the lack of an adequate nutrient database and limited educational efforts, urban dwellers are not taking advantage of these resources. It is extremely disappointing that our policymakers regard these wild species as 'agricultural weeds'. It would be tragic if this resulted in the loss of the ability to identify and consume these vital available resources. We should encourage the inclusion of wild edible plants in our regular diets so that there indigenous knowledge can be passed down to the future generations.

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6

TRADITIONAL KNOWLEDGE OF ETHNOMEDICINE AMONG THE BAIGA TRIBES OF MAIKAL HILLS OF CENTRAL INDIA

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Abstract

Present study explores the unique indigenous knowledge system of the Baiga tribe, a particularly vulnerable tribal group in central India. Focusing on their traditional healing practices, the paper delves into the Baiga community's use of ethnomedicine, showcasing their profound understanding of medicinal plants and their sustainable lifestyle. Through qualitative research method, including in-depth interviews with Baiga traditional healers, the study presents a comprehensive list of medicinal plants used by the community. The Baiga's holistic approach to healing involves not only the practical application of herbal remedies but also a deep spiritual connection with nature and deities. The article emphasizes the Baiga tribe's role as custodians of their environment, contributing to the conservation of medicinal plants and fostering a sustainable coexistence with forests and wildlife. Despite the challenges of modernisation, the Baiga community remains steadfast in preserving its indigenous knowledge, passing it on orally to future generations. The research underscores the need for further exploration of these practices and their implications for healthcare and conservation efforts.

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INTRODUCTION

The Baiga tribe is considered the particularly vulnerable tribal group of central India. The indigenous Baiga tribal community is known for its unique ethnic culture and customary lows. The Baiga tribe lives on the banks of the Narmada River between the Maikal and the Satpura mountain ranges (Singh and Deewan, 2018). Their traditions, lifestyle, folk art, religion, rituals and activism, and awareness of nature conservation make them unique. The Baiga tribe has been explored and studied by various researchers, like George Grierson, Captain Thomson, Colonel Bloomfield, Grierson, R.V. Russell, Hiralal, Verrier Alvin, Dilip Singh, Amit Soni, as reported by Chaurasia (2009). It is said that the word Baiga is derived from the Sanskrit word *Vaidya*. Each tribal community has unique skills and identity. Baiga communities contribute as traditional healers to other tribal communities. The Baiga community has an amazing ability to identify medicines, test their properties and use their spiritual power. The Baiga community follows the methods of conservation of forest and vegetation in their daily life and culture. In the folk culture of the Baiga tribe, nature is worshiped in various forms in folk festivals, and it is also worshiped through folk dance and folk songs. Worshiping nature through Baiga folk song, Reena sings:

Tore Hare Nana Ho Tore Hare Nana, Bhala Tore Nana Ho Tore Hare Nana

Tohiki Sumiro Hey Mai Dharti Aaj, Tohiki Lagi Bhar

Tohiki Sumiron Re Baba Dongar Dauhar, Tohiki Lage Bhar

Tohiki Sumaro Re Vanaspatti, Tohiki Lage Bhar

Tohiki Lage Re Hansa Udaan, Tohiki Lage Re Bhar.

This song is dedicated to mother nature. The Baiga community sings this song for worship, saying, “Oh, our mother earth, today all are worshiping you. We are immersed in your faith. Oh, our father mountain, today all are honoring you. We are immersed in your faith. Oh, our well-wisher nature, today all are worshiping you. We are immersed in your faith. Oh, our pure body, today all are worshiping you. We are immersed in your faith."

According to Chaurasia (2009), there are seven branches of the Baiga community, of which Bhumia is one. The word *Bhumia* means the owner of the land. It is believed by this tribal group that Bhumia were the first to appear on this earth, hence they are known as the owner of the land. The nature worshiper, Baiga considers himself the son of nature (*Prakriti-Putra*). The Baiga tribe presents a strong example for leading a sustainable and responsible life with forests and wildlife.

The Baiga: A Traditional Healer

The Baiga tribe reside in the dense forest or foothills area, far away from the city and modern healthcare facilities. The Baiga community leads a healthy life by adopting herbal medicine. The Baiga community remained utterly safe even during the COVID-19 pandemic. A significant reason for this is their natural lifestyle and naturopathy system. The Baiga traditional healers are the medicine man for other tribes. The traditional healers used to give herbal medicine for any disease based on their traditional knowledge of the medicinal practice (Dwivedi et al., 2019). They used to practice herbal medicine and find a suitable way of use with the conservation of plants (Bhagabati et al., 2019). In the religious literature Srimad Bhagwat Geeta, Lord Sri Krishna said that *Aham kraturahm yagyah swadhahamhamaushdam,* it means "I am the medicine and I am *Ashwath (Pipal)* in the trees." Our great culture and religion also mentioned medicinal importance of plants and trees. Very early, the Baiga tribes understood the importance of medicinal plants and adopted them in their life. Baiga men mainly practice the healing system while women of the community does not, even though they have enough knowledge about the medicinal plants and their uses. They can identify plants, trees, insects, and other forest animal behaviours. This expertise in identification makes Baiga tribe more special than other tribes. Different tribes address Baiga men and women as *Mitan* and *Mitanin* (family friends) respectively.

METHODOLOGY

The present chapter elaborated on traditionally usable ethnomedicine by the Baiga traditional healers. The research adopted a qualitative approach for this chapter. In-depth interview was conducted with two famous Baiga traditional healers of Amarkantak. Prior informed consent was taken before the interview and photographs, and permission obtained to publish their traditional knowledge. The perception of people, such as doctors, teachers, scientists, forest officers and those working with Baiga healers and ethnomedicine was also received from different backgrounds of tribal and non-tribal communities. Thorough literature survey was made to study and understand the subject in other dimensions.

RESULT

A total of 22 species of 19 families of the plant kingdom have been studied in this chapter which are used by the Baiga traditional healers of Maikal hills. The Baiga and other forest-dwelling tribal habitats are far from the modern healthcare facility. Only the ethnomedicines have saved the life of the local people. The Baiga traditional healers have been practicing this since ages. They used to cure normal fever to severe diseases, such as viral fever, cough, ulcer, diarrhea, stomach bug, tonsils, headache, digestion issues, gonorrhea, jaundice, diabetes, constipation, skin disease, itching arthritis, leprosy, a blood disorder, mania disease, stone, menstrual disorder, hemorrhage, heart disease, cancer and so on. Apart from this, Baiga healers treat many more diseases using ethnomedicines.

Table 6.1: List of Medicinal Plants Used by the Baiga Traditional Healers

Sr. No.	Scientific name	Family	Local name	Uses
1.	*Melia azedarach* L.	Meliaceae	Bakayan	1. Leaf is useful for cough, leprosy, blood disorder, vomiting, diarrhoea, hallucinations, breathing problems, stomach bugs of animals, etc. 2. Seed powder is useful for piles.
2.	*Aegle marmelos* L.	Rutaceae	Bael / Bel	1. Leaf paste can cure severe headache. 2. It is useful for night blindness, deafness, respiratory diseases and stomachache. 3. It is useful for tuberculosis.
3.	*Phyllanthus niruri*	Phyllanthaceae	Bhui-Awala	1. It is useful for diabetes, stomachache, mastitis and gonorrhea. 2. It is effective for hair disease.
4.	*Bacopa monnieri*	Plantaginaceae	Bramhi	1. It is useful for memory power, sleep deprivation and mania disease.

				2. It is useful for hair, voice problems, rash, and for blood pressure.
5.	*Oxalis corniculata*	Oxalidaceae	Changeri, Tinpatiya	1. Its leaf is useful for headache, gum pain and halitosis. 2. 2–5 grams of leaf juice twice a day can cure diarrhoea. 3. Decoction of the leaf is effective for fever.
6.	*Datura stramonium*	Solanaceae	Dhatura	1. Its 2–3 seeds can cure headache. 2. It is beneficial for removing head lice. 3. Its seed is useful for mania. 4. Leaf juice give relaxation in eye-related problems.
7.	*Cynodon dactylon*	Poaceae	Doob	1. Paste of *doob* and lime can cure headache. 2. Its juice is useful for nosebleed. 3. It is useful for leucorrhoea disease. 4. Its paste with sugar candy should be used twice a day for treatment of stones.

8.	*Swertia chirayita Buch.*	Gentianaceae	Chirchita	1. Leaf juice is useful for toothache. 2. Powder of root is useful for eye disease, ear problems, cough and breathing disease. 3. Root juice is effective for relief from menstrual pain and over bleeding.
9.	*Terminalia arjuna*	Combretaceae	Arjun	1. Very effective for heart disease and abnormal breathing. 2. Leaf juice is useful for ear pain and mouth disease. 3. It is useful for gonorrhea and hemorrhage.
10.	*Vachellia nilotica*	Fabaceae	Babul	1. 1–2 drops of leaf juice give relief in eye disease and throat disease. 2. Flower powder with sugar candy can cure jaundice. 3. It is useful for regular and smooth menstruation, white discharge, and nightfall.

11.	*Ficus benghalensis L.*	Moraceae	Bargad, Bar	1. Its leaf juice can be used for skin disease, hair disease and piles. 2. Its milk is useful for ear disease, toothache, eye pain and blurriness. 3. Its new root is useful for diabetes.
12.	*Terminalia bellirica (Gaertn.) Roxb.*	Combretaceae	Baheda	1. Powder is useful for eye pain, eye power, fever, heart disease and cough. 2. *Baheda* and *Harra* powder is useful for breathing and digestion problems. 3. It is one of the component of Trifala powder which is useful in many diseases.
13.	*Calotropis gigantea*	Apocynaceae	Aak, Oak, Akwan	1. It is useful for face spot, scalp itching and ear disease. 2. Root powder is useful for eye disease but its milk is dangerous for eyes. 3. It is useful for epilepsy.

14.	*Anacyclus pyrethrum*	Asteraceae	Akarkara	1. Root paste is useful for headache and throat cleaning. 2. Its powder is useful for heart disease. 3. Its flower is useful for toothache.
15.	*Cassia fistula* L.	Fabaceae	Amaltas	1. It is useful for cough, tonsils, breathing and gastric problems. 2. Leaf paste is useful for leprosy.
16.	*Phyllanthus emblica* L.	Phyllanthaceae	Amla, Awla, Amra	1. It is useful for eyes related problems. 2. It is useful for hair and nose bleeding. 3. It is one component of Trifla powder which is useful for digestion and many other diseases.
17.	*Psidium guajava* L.	Myrtaceae	Amrud, Bihi	1. It leaf is effective for toothache, mouth ulcer and cough. 2. It is useful for heart disease, constipation and arthritis.

18.	*Cissus quadrangularis* L.	Vitaceae	Hadjod	1. The green stem juice is used for bone and joint wellness. 2. It is useful for digestion, ulcer, in cramps, gout and piles.
19.	*Curcuma aromatica*	Zingiberaceae	Van Haldi	1. This is useful for joint pain, blood purification, swelling, itching, etc.
20.	*Dryopteris sp.*	Dryopteridaceae	Jatashankari	1. Root paste is useful for hair fall and baldness. 2. It is useful for cough, heart disease, eye disease and headache.
21.	*Semecarpus anacardium* L.f.	Anacardiaceae	Bhelma	1. People of some tribal communities' burn it around the house after having a child so that any kind of germs do not reach the woman and infant. 2. Fruit is useful for skin disease.

22.	*Terminalia chebula* Retz.	Combretaceae	Haritaki	1. Fruits are used in asthma, gall stone, UTI and mouth ulcer. 2. Root paste is useful for conjunctivitis. 3. Tribal women eat fruit paste for abortion and also use it for chronic ulcers.
23.	*Hedychium coronarium*	Zingiberaceae	Gulbakawali	1. The effective eye drop is made with its flowers. 2. Root paste is useful for severe headache.

DISCUSSION

The traditional healers of the Baiga community used to worship nature and their deities on several occasion. Before plucking a leaf, flower, fruit, root or bark, they would seek permission from the plant. And the same is followed during the treatment of any patient; they would request the diety of herbal medicine, i.e., *Van Dev, Van Devi, Dharti Mai, Narmada Mai, Dongar Dev, Thakur Dev, Budhi Mai* and so on. The traditional healers of the Baiga community are of two types: those who use only herbal medicinal plants for treatment called *Vaidya* and those who heal through exorcism (*Jhad-Phook* with Mantras) and also using herbal medicine called *Dewar/Guniya Vaidya*. The Baiga herbal practitioners have the ability to sense and identify usable and non-usable plants. They can also make a combo of different medicines with similarities, which creates an effective combination to cure a particular disease. Some plants used for curing various diseases and disorders by Baiga community healers are given in the Table 6.1.

CONCLUSION

The Baiga tribal community is far from modernisation and strongly believes in its indigenous knowledge system. The road, transport and healthcare facilities reached many villages, but still many villages are left of such facilities, and villagers residing in these interior villages are regularly using traditional healing systems. On the other hand, roadside villagers having these facilities get benefit of modern healthcare facilities along with ethnomedicines. The Baiga traditional healers don't have any written document of knowledge. They orally transfer the knowledge from generation to generation (Kosalge and Fursule, 2009). The Baiga *Vaidya* transfer the knowledge to the suitable person only to whom they identify, either own child or other member of the community. They are very much concerned about the conservation of medicinal plants and nature. Many studies have been carried out in this regard, but many things still need to be explored further (Uniyal et al. 2006; Ahirwar, 2010; Pandey, 2021; Kareti et al., 2022; Narayan and Singh, 2017; Wagh and Jain, 2020).

ACKNOWLEDGMENTS

We thank traditional healer Sri Thunu Markam (Thunu Baiga, 85 years) from Kapila Sangam and Bhaina Baiga (66 years) from Jamunadadar of Amarkantak, who provided all the information regarding the Baiga healing system. We are also thankful to the villagers of Amarkantak, officers from the forest department, Amarkantak range, Bhagwati Krishnamani, Anushka Atram and Sapna Dwivedi who helped in collecting data and for providing guidance during the research work.

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7

WILD EDIBLE FRUITS OF UTTARAKHAND HIMALAYA: A POTENTIAL SOURCE OF NUTRACEUTICAL

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Abstract

In recent decades, interest in the nutraceuticals has amplified due to its immune-stimulatory potential. Different species of wild edible fruits have beneficial properties such as anti-cancerous, anti-proliferative, anti-inflammatory, antioxidant, anti-hypertensive, antithrombotic, anti-malarial, antifungal, anti-diabetic, hypoglycemic, anti-asthmatic, anti-aging and immune-modulatory effects. These properties are concentration dependent, and in most cases, no adverse effects were reported. The present study was performed to determine the nutritional value/properties, mineral profile and phytochemical analysis of ten wild edible fruits including Aegle marmelos, Berberis asiatica, Carirssa opaca, Ficus palmata, Ficus auriculata, Myrica nagi, Pyracantha crenulata, Pyrus pashia, Rubus ellipticus and Ziziphus jujuba for exploring and developing new, safe and potent nutraceuticals. The extraction was carried out by fractionations with different solvents while the nutrients and minerals present in all ten fruits were analysed by using Association of Official Analytical Chemists (AOAC) methods and Inductively Coupled Plasma– Mass Spectrometry (ICP–MS) technique. The results revealed the presence of significant amount of nutrients and minerals in all ten wild edible fruits. Phytochemical investigation revealed presence of carbohydrates, glycosides, flavonoids, phenolics, anthocyanins, carotenoids, unsaturated sterols, terpenes, tannins, etc., besides proteins and amino acids.

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The comparative assessment of selected wild edible fruits with cultivated fruits in respect of their nutrient composition has been reported. The Biochemical investigation showed that wild edible fruits contained higher value of protein, fats, dietary fibre and minerals as compared to the cultivated fruits. Ficus auriculata and Berberis asiatica were shown to be the most promising species. All wild edible fruits have low calorific value and possess high per cent of minerals and secondary metabolites, which are more useful in the case of obesity.

Keywords: *Wild Edible Fruits, Uttarakhand Himalaya, Nutraceutical, Secondary Metabolites, Immunostimulatory, antioxidant*

INTRODUCTION

The Himalayan region of Uttarakhand is highly enriched with its vegetation including wild edible fruits due to its geographical and altitudinal variations. These fruits are consumed by local inhabitants and play a significant role as supplementary food. They are especially beneficial in those areas where there is a limited availability of fruits in the market. Wild edible fruits cover a wide range of taste, flavours, colours, ripening season and are free from pesticides, insecticides and fertilisers. Thus, these wild edible fruits are generally irrigated by rainfall only, and grow according to natural seasonal cycle, within specific climatic zone and having natural adaptation. Different colours of wild edible fruits are due to natural plant pigments, many of which are flavonoids, isoflavonoids, anthocyanins, carotenoids, phenolics and tanins localised in the skins and seeds of the fruits. They contain whole range of plant-derived dietary supplements, phytochemicals, pro-vitamins that assist in maintaining good health and combating disease, and also play a vital role in nutrition. Wild fruits are used for human consumption because of their assumed health benefits for which they could be categorised as medicinal foods and nutraceuticals. The wild edible fruits are the best source of nutraceutical. A food-based approach instead of a drug-based approach needs to be adopted to conquer chronic diseases. Along with the objective of making people aware of nutraceutical potential of wild edible fruits and vegetables, it needs to be popularised and publicised for their availability, palatability and overall acceptability. The preparations of nutraceuticals in the form of tablets, capsules and syrups besides jam, jelly, sauces, soft drinks and so on, will provide natural organic products for people at distant places. Since the food and phyto–resources are shrinking globally with the hike in population, it is the need of the hour to find new alternatives for enriching the resource base of our food basket.

Nutraceutical potential is generally attributed to the presence of phytochemicals, nutrients and antioxidant activity. These protective plant compounds are an emerging area of nutrition and health. Nutrients help slow down the aging process and reduce the risk of many chronic diseases, including cancer, heart disease, stroke, high blood pressure, cataract, osteoporosis and urinary tract infections. The fruits under investigation are gathered, grown or produced locally and prepared into dishes, which often represent local specialties and this is a part of the traditional knowledge which is orally transmitted through generations to generations. Often dietary tradition is not written but certainly, this knowledge is a vital part of the traditional knowledge system of a particular area. Knowledge of such foods is there in the cultural tradition of many ethnic communities and as such considered as traditional knowledge (Mishra et al., 2008). Low fruit and vegetable consumption is regarded as one of the main risk factor for mortality in the world (WHO, 2009). However, modern lifestyles are quickly transforming traditions and the consumption of wild edible fruits is not as common as it was in the past. However, wild edible fruits and vegetables are known to be excellent source of nutrients, such as minerals, vitamins, carbohydrates and other food components (Orech et al., 2007), and they may contribute an important part of diet providing health and nutrition while serving as an appetiser. According to Olorode (2004), wild foods could become useful vehicles for improved nutrition and increased food supply.

Human beings need an appreciable amount of nutrients in their diet to perform various body functions and to lead a healthy life. The nutrients include proteins, fats, carbohydrates, vitamins, minerals and fibre as roughage. An average Indian of 60 kg body weight, doing moderate physical and mental work requires 60 gm protein, 20 gm fat, 28 mg iron, 40 mg vitamin C, total 2875 kcal energy in the daily diet (NIN, 2009). The dietary habits of the ethnic communities in different regions are usually determined by the availability of local foods, and satisfaction of hunger is the primary goal of their food intake. They may not be nutrition-specific in most occasions.

Information available on wild edible fruits of Uttarakhand Himalaya as well as therapeutic data on their nutritional composition is negligible. Therefore, the present scientific work is aimed at the estimation of nutritional value of wild edible fruits along with their collection, identification, recording vernacular names, and documenting their distribution and availability in Uttarakhand. The study area and wild edible fruits available in those areas are shown in Figs. 7.1 and 7.2 respectively.

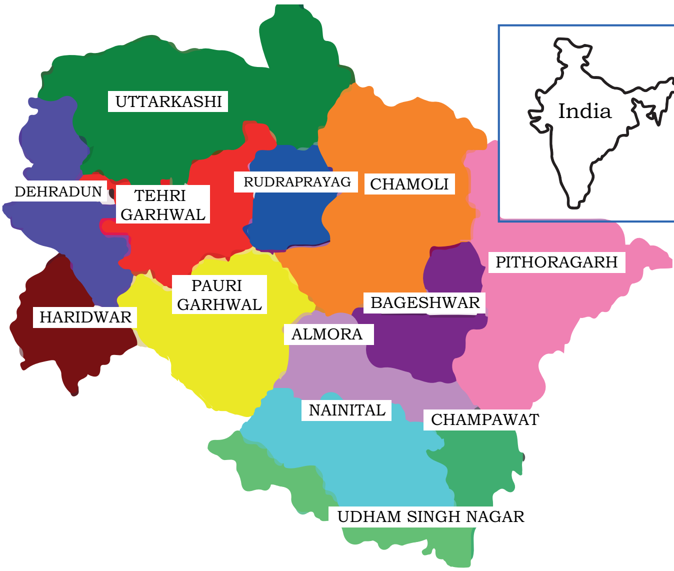

Fig. 7.1: Study Area, Uttarakhand Himalaya

Fig. 7.2: Wild Edible Fruits of Uttarakhand Himalaya

MATERIAL AND METHODS

All chemicals and reagents, such as sodium hydroxide, methanol, ethyl alcohol, hydrochloric acid and sulphuric acid, used in the study were of analytical grade and purchased from Merck (India).

Plant Material or Wild Edible Fruits

Fresh wild edible fruits of *Aegle marmelos, Berberis asiatica, Carissa opaca, Ficus palmata, Ficus auriculata, Myrica nagi, Pyracantha crenulata, Pyrus pashia, Rubus ellipticus* and *Ziziphus jujuba* were collected from Ghansali block of Tehri Garhwal, Uttarakhand, India. All these wild edible fruits were authenticated by Taxonomy Laboratory, Department of Botany, H.N.B. Garhwal University Srinagar Garhwal, India. The voucher specimens of all ten fruits have been deposited in the Herbarium section Department of Botany for future use.

Preparation of Extracts

The ten selected wild edible fruits were then air dried, ground to moderately fine powder and extracted with soxhlet with increasing polarity in the solvent (petroleum ether, chloroform, ethyl acetate, acetone, alcohol and water). Each extract was evaporated to dryness under reduced pressure using a rotary evaporator. The concentrated extracts were stored in the airtight containers in a refrigerator for further studies.

Nutritional and Mineral Assay

The edible portions of the fruits were analysed for moisture, ash and fat content as prescribed method by Iswaran (1980), whereas the measurement of total dietary fibre was done as per method reported in AOAC (Association of Official Analytical Chemists, 2000). Total nitrogen was analysed by the micro–kjeldhal method, and for crude protein, the value of nitrogen was multiplied by 6.25 (Ward, 1962). Total carbohydrates were determined by subtracting the values of moisture, crude protein, crude fat, crude fibre and ash from 100 per cent (Negi et al., 1992; Jayaraman, 1981). The total energy value is equal to the addition of fat, protein and sugar calories, each gram of fat gives 9 kcal, protein and sugar give 4 kcal energy. The minerals analysed were sodium, potassium, calcium, magnesium, iron and phosphorus by ICP–MS (PerkinElmer SCIEX ELAN DRC-e) against salt standards. Ascorbic acid in fruits was estimated by standard methods.

Phytochemical Analysis

The qualitative phytochemical properties of the dried powdered samples were determined using standard methods. The extracts obtained as above were subjected to qualitative tests for the identification of various plant constituents. In addition, 50 gm of fresh fruits material was also subjected to hydrodistillation to detect the presence of volatile contents. The plant material was subjected to preliminary phytochemical screening for the detection of various constituents of plants as per methods described by Kokate (2005).

Detection of Chemical Compounds through TLC

Thin Layer Chromatographic (TLC) plates are prepared by spreading silica gel G on glass plate using distilled water as solvent. These plates are activated in oven at 110° C for 1 hour. All ten extracts were applied separately and allowed to run in different solvent system of varying polarity and qualitative analysis of amino acids was carried out. These plates are developed in UV–Visible chamber, Iodine chamber and spraying reagent for different spots and Rf value of chemical constituent was calculated.

RESULTS

Biochemical and Chemical Analysis

Based on the folklore, some hitherto unexplored genera are used frequently by local inhabitants. These wild edible fruits (*Aegle marmelos, Berberis asiatica, Carissa opaca, Ficus palmata, Ficus auriculata, Myrica nagi, Pyracantha crenulata, Pyrus pashia, Rubus ellipticus* and *Ziziphus jujuba*) selected for their biochemical and chemical analysis are listed in the Tables 1–5. Following fruits are taken for nutritional evaluation—

1. *Aegle marmelos,* 2. *Berberis asiatica,* 3. *Carissa opaca,* 4. *Ficus palmata,* 5. *Ficus auriculata,* 6. *Myrica nagi,* 7. *Pyracantha crenulata,* 8. *Pyrus pashia,* 9. *Rubus ellipticus,* 10. *Ziziphus jujuba.*

Table 7.1: Phytochemical screening of wild edible fruits

Test	Wild Edible Fruits									
	1	2	3	4	5	6	7	8	9	10
Carbohydrates/glycosides										
1. Molisch test	(+)	(+)	(+)	(+)	(+)	(+)	(–)	(+)	(+)	(+)
2. Fehling test	(+)	(+)	(+)	(+)	(+)	(+)	(–)	(+)	(+)	(+)
3. Benedict test	(+)	(+)	(+)	(+)	(+)	(+)	(–)	(+)	(+)	(+)
Alkaloid										
1. Mayer's test	(+)	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)
2. Dragendorff's test	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)
Flavonoid	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)
Saponins	(–)	(+)	(–)	(–)	(–)	(–)	(+)	(–)	(–)	(–)

Tannins										
1. Pyrogallol and catechol	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(−)	(−)	(+)
2. Gallic acid	(−)	(−)	(−)	(−)	(−)	(−)	(+)	(−)	(−)	(−)
Unsaturated sterol/ triterpenes										
1. Liebermann-Burchard test	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(−)	(−)	(+)
2. Salkowski's test	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(−)	(−)	(+)
Resin	(+)	(+)	(+)	(−)	(−)	(+)	(+)	(−)	(−)	(+)

Table 7.2: Qualitative estimation for amino acid contents in the wild edible fruits

Amino acid test	Wild Edible Fruits									
	1	2	3	4	5	6	7	8	9	10
L-Hydroxyproline	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)
DL-Serine	(+)	(+)	(+)	(−)	(+)	(+)	(+)	(+)	(+)	(+)
DL-Isoleucine	(−)	(−)	(−)	(−)	(−)	(−)	(−)	(−)	(−)	(−)
DL-Valine	(−)	(−)	(−)	(−)	(−)	(−)	(−)	(−)	(−)	(−)
DL-2-Aminobutyric acid	(+)	(+)	(+)	(+)	(+)	(−)	(+)	(+)	(+)	(+)
L-Ornithin	(−)	(−)	(+)	(−)	(+)	(−)	(−)	(−)	(−)	(−)
L-Cysteine hydroxy	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)
DL-Norleucine	(+)	(+)	(+)	(+)	(+)	(−)	(+)	(−)	(−)	(−)
DL-Tryptophan	(−)	(−)	(−)	(−)	(−)	(−)	(−)	(−)	(−)	(−)
DL-Alanine	(−)	(−)	(−)	(−)	(−)	(−)	(−)	(−)	(−)	(+)
L-Glutamic acid	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)
Glycine	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)
L-Proline	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)
L-Arginine	(−)	(−)	(−)	(−)	(−)	(−)	(−)	(−)	(−)	(−)
DL-Aspartic acid	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)
L-Cysteine hydrochloride	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)
L-Histidine	(−)	(−)	(−)	(−)	(−)	(−)	(−)	(−)	(−)	(−)
L-Leucine	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)
L-Lysine monochloride	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)
DL-Methionine	(−)	(−)	(−)	(−)	(−)	(−)	(−)	(−)	(−)	(−)

DL-β-Phenyl alanine	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)
DL-Threonine	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)
L-Tyrosine	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)
3,4-Dihydroxy-l-phenylalanine	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)

Table 7.3: Nutritional value of wild edible fruits (gm/100 gm) of Garhwal Himalaya

S. No.	Plant Name	Protein (gm/ 100 gm)	Fibre (gm/ 100 gm)	Fat (gm/ 100 gm)	Moisture (gm/ 100 gm)	Ash (gm/ 100 gm)
1.	*Aegle marmelos (Bael)*	2.4	3.2	0.5	62.5	1.6
2.	*Berberis asiatica (Kingor)*	3.3	3.12	0.8	65.2	2.6
3.	*Carissa opaca (Karonda)*	1.3	3.4	0.82	76.6	1.25
4.	*Ficus auriculata (Timla)*	5.32	16.96	0.65	46.64	3.7
5.	*Ficus palmata (Bedu)*	4.6	17.65	4.71	48.2	4.06
6.	*Myrica nagi (Kaphal)*	0.97	1.91	0.67	78.2	1.87
7.	*Pyracantha crenulata (Ghingaru)*	5.13	7.4	1.0	60.1	1.5
8.	*Pyrus pashia (Mahal)*	3.28	5.26	1.62	60.36	1.1
9.	*Rubus ellipticus (Hinsar)*	3.68	2.35	0.96	64.60	1.3
10.	*Ziziphus jujuba (Ber)*	4.26	6.12	2.5	50.23	2.58

Table 7.4: Mineral Contents of wild edible fruits (mg/100 gm) of Garhwal Himalaya

S. No	Plant Name	Calcium (mg/ 100 gm)	Magnesium (mg/ 100 gm)	Nitrogen (mg/ 100 gm)	Potassium (mg/ 100 gm)	Phosphorus (mg/ 100 gm)
1.	*Aegle marmelos (Bael)*	0.85	0.94	0.38	1.12	0.5
2.	*Berberis asiatica (Kingor)*	0.065	0.061	0.52	0.44	0.79
3.	*Carissa opaca (Karonda)*	1.0	8.4	0.2	1.98	0.24
4.	*Ficus auriculata (Timla)*	1.35	0.9	0.85	2.11	0.28
5.	*Ficus palmata (Bedu)*	1.54	0.92	0.73	1.58	1.88
6.	*Myrica nagi (Kaphal)*	0.39	0.13	0.15	1.97	0.07
7.	*Pyracantha crenulata (Ghingaru)*	1.78	0.96	0.82	2.75	0.82
8.	*Pyrus pashia (Mahal)*	0.75	0.12	0.52	3.21	0.86
9.	*Rubus ellipticus (Hinsar)*	0.95	5.6	0.58	1.82	0.2
10.	*Ziziphus jujuba (Ber)*	1.16	0.87	0.68	2.98	0.73

Table 7.5: Nutritional value of cultivated fruit (gm/100 gm)

S. No.	Plant Name	Protein (gm/ 100 gm)	Fat (gm/ 100 gm)	Fibre (gm/ 100 gm)	Moisture (gm/ 100 gm)
1.	Apple	3.89	0.23	1.85	83.89
2.	Pineapple	1.81	0.95	1.5	82.83
3.	Guava	0.02	1.16	0.01	92.43
4.	Jackfruit	0.95	2.09	1.89	87.33
5.	Mangosteen	3.01	2.31	2.09	81.72
6.	Pomegranate	0.61	0.21	3.1	86.91
7.	Sapota	0.28	0.01	0.9	82.29
8.	Mango	1.29	2.76	1.13	79.27
9.	Papaya	1.38	7.03	1.9	78.8
10.	Amla	0.58	0.24	2.88	86.6

Table 7.6: Comparison of cultivated and wild edible fruit for protein content (gm/100 gm)

S. No.	Cultivated edible fruit	Wild edible fruit
1.	Apple	*Bael*
2.	Pineapple	*Kaphal*
3.	Guava	*Mahal*
4.	Jackfruit	*Hinsar*
5.	Mangosteen	*Ber*
6.	Pomegranate	*Kingor*
7.	Sapota	*Karonda*
8.	Mango	*Timla*
9.	Papaya	*Bedu*
10.	Amla	*Ghingaru*

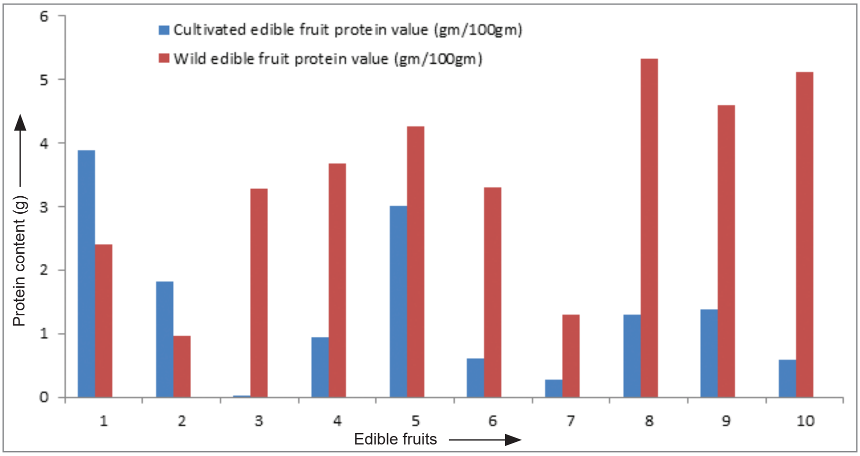

Fig. 7.3: Comparison of cultivated edible fruits and wild edible fruits for protein content (Adult per day intake protein is 60 gm)

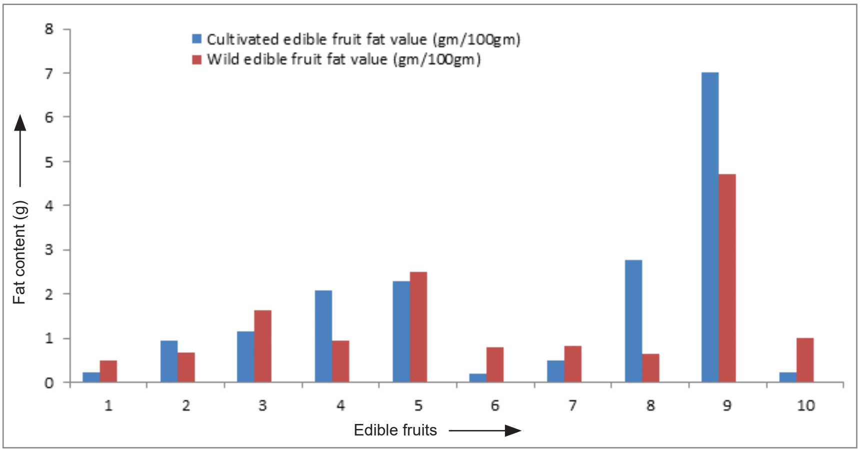

Fig. 7.4: Comparison of cultivated edible fruits and wild edible fruits for fat content (Adult per day intake fat is 60gm)

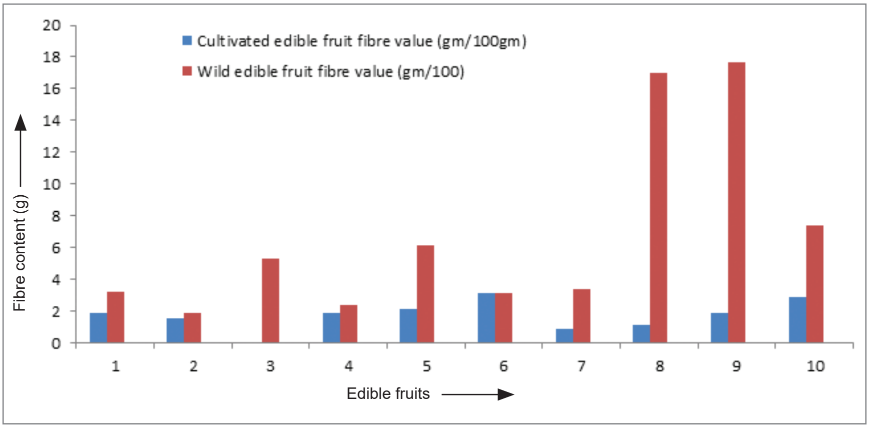

Fig. 7.5: Comparison of cultivated edible fruits and wild edible fruits for fibre content (Adult per day intake fiber is 25gm)

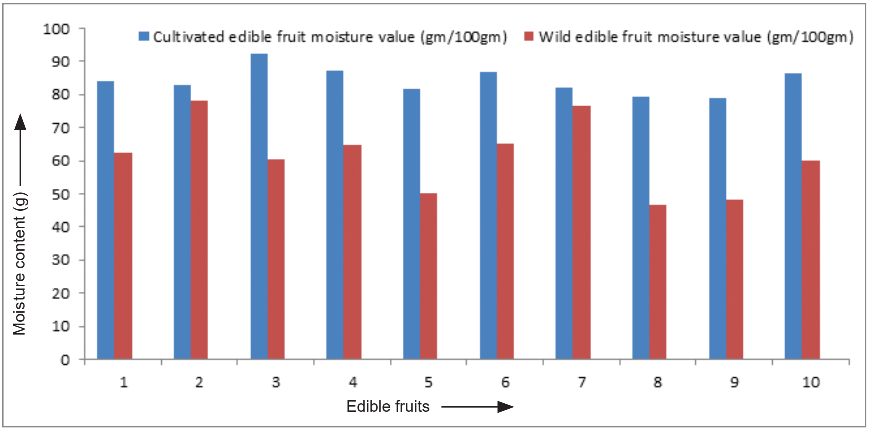

Fig. 7.6: Comparison of cultivated edible fruits and wild edible fruits for moisture content (Adult per day intake 5 L)

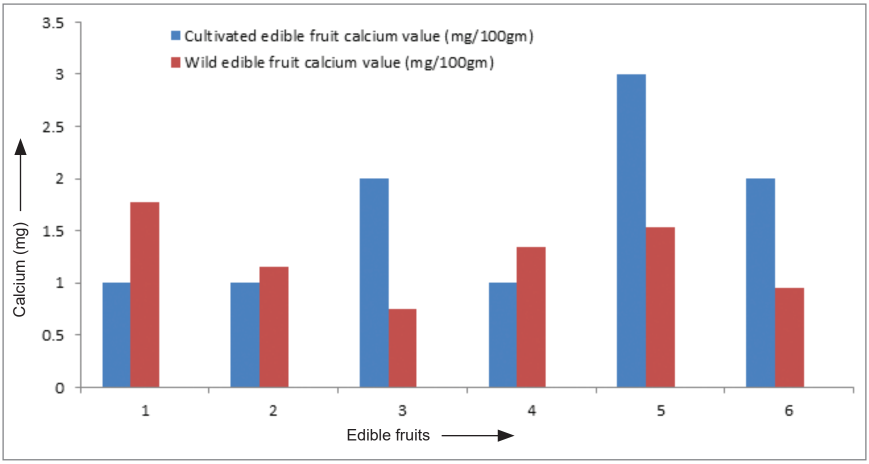

Fig. 7.7: Comparison of cultivated edible fruits and wild edible fruits for calcium (Adult per day intake is 600 mg)

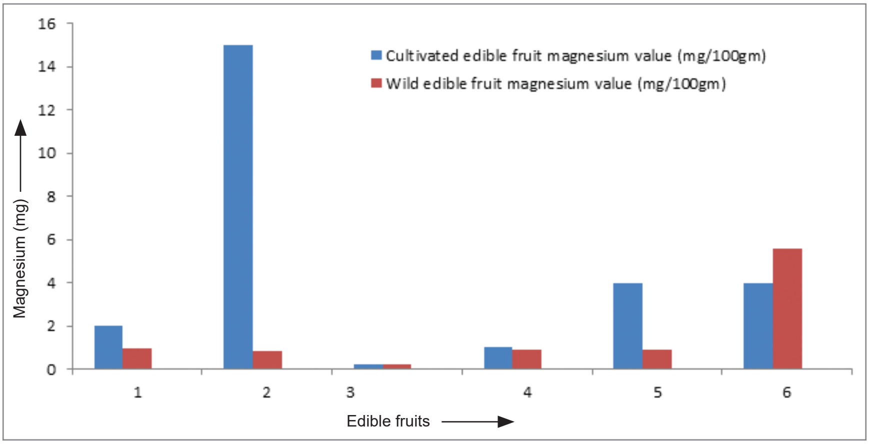

Fig. 7.8: Comparison of cultivated edible fruits and wild edible fruits for magnesium (Adult per day intake 340 mg)

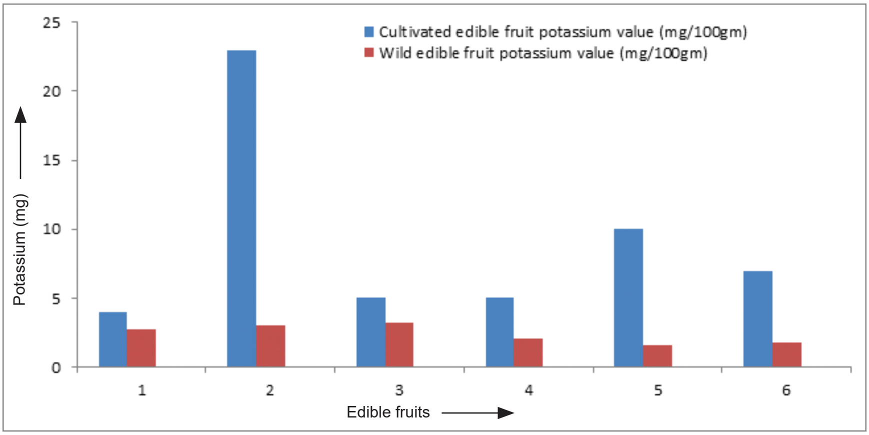

Fig. 7.9: Comparison of cultivated edible fruits and wild edible fruits for potassium (Adult per day intake is 3750 mg)

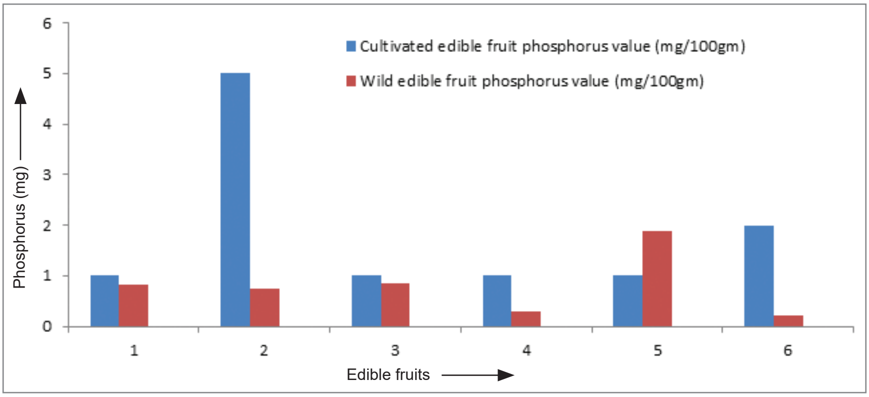

Fig. 7.10: Comparison of cultivated edible fruits and wild edible fruits for phosphorus (Adult per day intake 600 mg)

DISCUSSION

Most of the fruits undertaken for scientific investigation contain more minerals than cultivated popular fruits. Wild varieties tend to be richer in micronutrients and bioactive secondary metabolites, which are produced in adaptation to local environmental conditions. These metabolites trigger further adaptive responses by producing 'protective' bioactive compounds, which when ingested by insects/ pests result in protective effects on host organism.

Most of the wild fruits have higher nutritional values as compared to levels found in cultivated fruits. *Ficus auriculata* was found to be the best source of protein, containing 5.32 per cent of it. The protein content of some other fruits, viz., *Aegle marmelos, Berberis asiatica, Carissa opaca, Ficus palmata, Myrica nagi, Pyracantha crenulata, Pyrus pashia, Rubus ellipticus* and *Ziziphus jujuba*, was 2.40, 3.30, 1.30, 5.32, 4.6, 0.97, 5.13, 3.28, 3.68, 4.26 per cent respectively, thus the noticed quantities being quite good. The fruits like *Myrica nagi*, *Rubus niveus*, etc., are very good in taste but not very rich in protein.

The total content of sugar in all the fruits under study varied from 30.82 per cent in *Ziziphus jujuba* to 16.38 per cent in *Myrica nagi*. Other fruits have high percentage of sugars as *Aegle marmelos, Berberis asiatica, Carissa opaca, Ficus auriculata, Ficus palmata, Pyracantha crenulata, Pyrus pashia* and *Rubus ellipticus*, containing 29.80, 24.98, 17.39, 27.09, 20.78, 28.38, 27.11 per cent sugar respectively. These fruits contain more sugar than even apples do. Among all the fruits studied during the present investigation, *Ficus palmata* was found to be the richest source of minerals, containing 4.06 per cent. The fruit was followed by *Ficus auriculata, Berberis asiatca, Ziziphus jujuba, Myrica nagi, Rubus ellipticus, Carissa opaca* and *Pyrus pashia* whose mineral content exceeded approximately 2.0 per cent. Although all the ten fruits described are eaten, yet some of them are exceptionally suitable for fresh consumption, because their dessert quality ranges from good to excellent. Some such fruits are *Aegle marmelos, Berberis asiatica, Myrica nagi, Rubus ellipticus, Ficus palmata* and *Ziziphus jujuba*. While the other fruits are less popular for eating fresh.

CONCLUSION AND FUTURE PROSPECTIVE

The study analysed the scientific investigation regarding the wild edible fruits along with their beneficial effects such as nutritional value, mineral contents and presence of various phytochemical constituents. Various studies have reported the promising effects of phytochemicals on human health; however, further detailed studies related to the possible synergistic and antagonistic activities among the constituents of wild edible fruits are necessary. Similarly, if the constituents like glycosides, flavonoids, carotenoids, phenolics, terpenoids, etc., are to be supplemented in larger concentrations, then maintaining the health could be a challenge. In the past, the testing procedures for measuring the efficacy of formulations of nutraceuticals were very less standardised. In the present scenario, standard methods could speed-up the analysis of phytochemical constituents and their antagonistic or synergistic action over each other and on nutrient ingredients. Furthermore, additional studies related to safety and toxicity are also necessary.

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8 NATIONAL EDUCATION POLICY-2020: CRITICAL CURRICULAR INSIGHTS ON ENVIRONMENT EDUCATION

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It is our fundamental duty to protect and improve the natural environment including forests, lakes, rivers and wildlife, and to have compassion for living creatures.

(Indian Constitution, Fundamental Duty 07)

Today, the criticality of research is more than ever before, for the environmental, economic, intellectual, societal, and technological health and progress of a nation.

(National Education Policy-2020)

As we know from the above given statements from our constitution and National Education Policy-2020, significance and importance of Environment education needs no introduction in present times, especially in context of recent worldwide COVID-19 pandemic, which compelled everyone to pause in the present fast-paced life and reflect seriously on the possible ecological footprints we are leaving on mother earth. This apprehension with regard to environmental degradation is not new, and the need of environmental conservation and preservation has long been realised. Today "humanity increasingly realises, after a long journey from Stockholm through Rio de Janeiro to Johannesburg, that a development paradigm that largely ignores the environment has disastrous

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consequences.” (Position paper-National Focus Group on Habitat and Learning, NCF-2005) Therefore, it can also be observed in various national and international efforts made in this context from time to time.

At present, the world is facing many environmental issues such as rapidly emerging pandemics and epidemics, loss of biodiversity, different kinds of pollution, global warming, overconsumption of traditional energy resources, disproportionate generation of waste of various kinds and inefficient techniques of garbage disposal to quote a few. If this pattern of exploitation of nature and natural resources does not stop and concerted efforts are not made to rejuvenate the earth, very soon we will end up consuming our all-present natural resources and making the earth non-suitable for the generation of new resources for the future generations. Therefore, it is crucial to realise the need and significance of conserving our environment, nature and natural resources and make efforts for sustainable living and sustainable development in various domains. This way planet earth will remain a place congenial, fertile and productive to support the needs of not only the present generations but for the future generations as well.

It is a well-known fact that environmental conservation and protection is not possible by a person or a group of people. Rather it has to be inculcated and developed in the thoughts and emotions of the entire human population. While environmental awareness and knowledge dissemination is required to be done on a mass level and should reach everyone irrespective of their age or different socio-cultural identities, young citizens of the nation must be especially encultured into the ways of perceiving the world as a big eco-family with all the organisms and the entire nature included in it. This can be done by developing a deep-rooted knowledge, attitude and culture of environment preservation and sustainable growth among the citizens of the nation. For this inclusion of environment education right from beginning of formal education of child is important. Therefore, the importance of making our students aware, sensitive, informed and active contributors in environment conservation and promotion is a quintessential need of the hour. This is also crucial to familiarise, sensitise and empower our educators across the stages, about the wide-ranging dimensions of Environment education and various strategies to implement the same.

ENVIRONMENT EDUCATION

Environment education is a process that "allows individuals to explore environmental issues, engage in problem solving, and take action to improve the environment. As a result, individuals develop a deeper understanding of environmental issues and have the skills to make informed and responsible decisions" (https://www.epa.gov/education/what-environmental-education). It is a process that aims at the "development of environmentally literate citizens who can compete in global economy, who have the skills and knowledge and inclinations to make well informed choices concerning the environment, and who exercise the rights and responsibilities of the members of a community. Environmental knowledge contributes to an understanding and appreciation of the society, technology and productivity and conservation of natural and cultural resources of their own environment" (wgbis.ces.iisc.ernet.in/biodiversity/sahyadri_enews/newsletter/issue22/art5.htm). "There are various components of environmental education such as—

- awareness and sensitivity to the environment and environmental challenges;
- knowledge and understanding of the environment and environmental challenges;
- attitude of concern for the environment and motivation to improve or maintain environmental quality;
- skills to identify and help resolve environmental challenges; and

- participation in activities that lead to the resolution of environmental challenges.

(https://www.epa.gov/education/what-environmental-education)

As we know that many national and international efforts have been made to contemplate on defining the broad and comprehensive concept of environment and environment education. "The recent developments such as, launching of World Conservation Strategy (1984), report of the World Commission on Environment and Development—Our Common Future—culminated into Agenda 21 agreed upon by 170 nations and adopted at the United Nations Conference on Environment and Development held at Rio de Janerio, Brazil in June 1992. The concept of sustainable development has become an integral component of EE (environment education) activities. In fact, EE is renamed as Environmental and Development Education in Agenda 21." Various goals have also been consensually evolved to streamline and give more focus to the process of imparting environment education on a wider scale. Final report of the Tbilisi conference also gives us three goals of environmental education, as given below:

i. To foster clear awareness of, and concern about, economic, social, political and ecological interdependence in urban and rural areas.

ii. To provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment.

iii. To create new patterns of behaviour of individuals, groups and society as a whole, towards the environment (UNESCO, 1977).

This is also important to understand that environment education is also not about following a particular line of thought or ideology, it should empower the people with skills to critically assess various sides of any issue, event or phenomena and move towards problem solving and decision making. Therefore, environment education should be understood much beyond just the information about the nature.

Environment Education in Schools and Some Critical Questions

If we look back in the recent past, we have an evident history of support and promotion of environment education. Beginning with Mahatma Gandhi's movement of basic education to Kothari commission (1964–1966) which called for bringing EE into the formal stream, we see a strong commitment in the official efforts. The movement of basic education launched by Mahatma Gandhi in 1937 was an early serious attempt of relating education in schools to local environmental needs. The essential elements of basic education were productive activity in education; correlation of the curriculum with productive activity and the social environment; and an intimate contact between the school and the local community. The education system in India incorporated some aspects of EE in school curricula as early as in 1930. The Kothari commission recommendations were implemented in 1977 when the curriculum for the 10+2 pattern of school education was developed at the national level by NCERT, and presented in the document, 'The Curriculum for the Ten-year School: A Framework' (1975). The National Policy on Education (NPE, 1988) and subsequent curriculum frameworks brought out by NCERT in 1988 and 2000 reiterated the importance of EE in school education. Thus, EE has been one of the priority areas of concern in all curriculum development programmes. The present status of EE in schools had its genesis in the National Policy of Education (NPE), 1986 (modified in 1992), in which 'Protection of the Environment' is stated as a common core around which NCF would be woven. The National Curriculum Framework for School Education (NCFSE), 2000 also lists EE as one of the concerns to be integrated into the curriculum. EE is a compulsory part of the syllabus in schools throughout the country (Position Paper-National Focus Group on Habitat and Learning; NCF, 2005).

"EE in schools invariably aims at providing children with knowledge, attitudes and skills so that they are equipped to contribute meaningfully towards the betterment of the environment and accomplish the goal of sustainable development. In the NCERT curriculum, the teaching of language and mathematics has been woven around the children's immediate environment in Classes I–II and EE has been reinforced as a component of the Art of Healthy and Productive Living (AHPL). In Classes III–V, separate textbooks for environmental studies have been provided. By and large, the textbooks of science and social science in most States/UTs include environmental concepts. Environmental concepts had been included in the NCERT curricula for the upper primary stage mainly through science and technology" (Teachers' Handbook on Environmental Education, 2011).

After understanding a brief historical journey of recent developments in the environment education in India, some of the central questions that are worth asking at the present juncture of 21st century are—

- What should be the aims/objectives and goals of teaching environment education in schools?
- What educational experiences can be provided in EE to help achieve these goals?
- How can these educational experiences be meaningfully designed/planned to achieve these objectives?
- How do we assess that these educational objectives have been achieved?

NEP-2020 RECOMMENDATIONS ON ENVIRONMENT EDUCATION

Recent national education policy of the country which came in 2020 and is in the process of implementation, also emphasises on the need and importance of an in-depth planning with progressive and concrete implementation of environment education at the grassroot level across the nation. Policy has advocated for a widespread reach of environment education across various groups of students. It has also highlighted an urgent need of changing our attitudes and values towards the environment and making it a part of our culture to respect, preserve and flourish the environment for our own sustainable development, growth and progress. Policy directs us to take concerted curricular and pedagogical initiatives for the introduction of various contemporary subjects such as artificial intelligence and design thinking. It is very important to note here that while writing these technological knowledge areas as contemporary areas of importance, policy also emphasises that holistic health, organic living, Environmental Education and Global Citizenship Education are also of utmost importance in contemporary times and must be undertaken at relevant stages to develop these skills in students at all levels. Very lucidly, policy states that the 'Knowledge of India' will include knowledge from ancient India and its contributions to modern India and its successes and challenges, and a clear sense of India's future aspirations with regard to education, health and environment. It means that, policy very clearly emphasises environment as one of the most important domains of knowledge and pedagogy along with health and overall education.

Along with acknowledging and promoting environment education as one of the foundations of contemporary education, policy gives us some concrete implementation guidelines as well. It says that "All efforts will be made to ensure timely availability of textbooks in schools. Access to downloadable and printable versions of all textbooks will be provided by all States/UTs and NCERT to help conserve the environment and reduce the logistical burden. Policy has also suggested the required changes in teacher education programmes. It guides that all B.Ed. programmes will include strong practice-cum-training in the form of in-classroom teaching at local schools. All B.Ed. programmes will also emphasise the practice of the Fundamental Duties (Article 51A) of the Indian Constitution along with other Constitutional provisions while teaching any subject or performing any activity. It will also appropriately integrate environmental awareness and sensitivity towards its conservation and sustainable development, so that environment education becomes an integral part of school curricula" (NEP, 2020).

With regard to higher education, policy encourages to make efforts for the attainment of holistic and multidisciplinary education. It states that the flexible and innovative curricula of all HEIs shall include credit-based courses and projects in the areas of community engagement and service, environmental education and value-based education. It further elaborates on the focal points of environment education and says that it will include areas such as climate change, pollution, waste management, sanitation, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, and sustainable development and living.

At the end, policy also warns us of the possible ill effects of many new upcoming technologies which might prove to be disruptive if not attended well. It warns us that many potentially disruptive technologies might change the way we live presently. Therefore, it is crucial to change the way we educate our students as well. We need to proactively and progressively educate them about clean and renewable energy, water conservation, sustainable farming, environmental preservation and other green initiatives. These aspects should receive prioritised attention in education.

Critical Curricular Insights and Pedagogical Interventions at School Level

Curricular insights

It is a well-known fact that curriculum is the sum total of experiences that is given to a learner in formal or informal educational setting. It is much broader, in-depth and philosophical decisions of: What will be taught? How will be taught? What methods will be used to teach it? And how the students will be assessed if they have learnt the given knowledge content? This is thus the crucial foundation of any effort in the direction of Environment Education. Therefore, considerable planning and thought should be given in setting the objectives for environment education at the school level and creating the syllabi, textbooks, teaching-learning material and pedagogical strategies.

According to the 'Environmental Education in the School Curriculum developed by the NCERT' in 1995, environmental concepts and related topics have been included in the instructional materials developed by the NCERT for different stages of school education. In the sixties, conservation concepts were introduced with the ideas promoted by the International Union for Conservation of Nature and Natural Resources (IUCN) at present known as World Conservation Union. Later on, the information on environment was updated in the school curricula in the light of the international inputs through the Stockholm Conference (1972) and the Tbilisi Inter-Governmental Conference (1977). Environmental education has received greater attention in school education with the implementation of the National Policy on Education (NPE) 1986 which has envisaged protection of the environment as the core element of education at all levels. The policy said that EE should be developed as one of values among the children. It has also recommended the creation of environmental consciousness among all ages starting with school education. The curricular materials developed as a follow-up of the policy have given due weightage to environmental concepts and related problems" (Environmental Education in the School Curriculum Developed by the NCERT, 1995).

According to the previous national curriculum framework-2005 (Position paper-National Focus Group on Habitat and Learning), "the new paradigm of education, embodying the spirit of science, democracy, and caring for the environment, should emphasise a number of key elements:

- learning rather than teaching;
- building capacity for critical thinking and problem solving;
- locale specificity in the context of a global vision;
- multidisciplinary approach;
- multi-sourced and accessed, rather than top-down, controlled and orchestrated nature;
- participation with broad involvement of peers and other community members;
- lifelong and continuous in character;
- sensitivity to diversity, equity and gender;
- knowledge generation; and
- empowerment, rather than indoctrination.

Thus, 'the main focus of EE should be to expose students to the real-life world, natural and social, in which they live; to enable them to analyse, evaluate and draw inferences about problems and concerns related to the environment; to add, where possible, to our understanding of environmental issues; and to promote positive environmental actions in order to facilitate the move towards sustainable development'. To achieve these goals, the curriculum may be based on:

- learning about the environment;
- learning through the environment;
- learning for the environment" (Environment Education as Infused in NCERT syllabus for Classes I to XII as per NCF-2005).

These objectives become all the more important after traveling through the stages of Stockholm through Rio de Janeiro to Johannesburg, we have all realised that development and growth without environmental sustainability will have disastrous consequences.

Currently we are in the process of development of new National Curriculum Framework in the light of the latest National Education Policy-2020, therefore, our focus should be to review the existing EE curriculum, textbooks, training modules and all the teaching-learning material (hard copies as well as digital) developed so far at the national and state level. We should also revisit and reconceptualise our pedagogical content knowledge in the field of environment education. We should assess the effectiveness of previous EE curriculum in dealing with environmental issue (natural and social both) at larger scale and also its success at grassroot level in bringing knowledge, attitude, skills and awareness among the masses. Only after a critical, comprehensive and in-depth review of the present status of environment education, a new progressive and culturally rooted curriculum framework can be developed. There is a need to contemplate and define the—

- overall aims/objectives and goals of the school education in present context;
- place of environment education in the school curriculum;
- strategies for an organic integration of environment education with other subjects of study.

It is very important that the curriculum framework discusses the need for environment education to be introduced since the beginning of various educational set-ups. It should deliberate on the form in which it will be taught at different stages of school. Issues, concerns and possible challenges in implementation should also be well thought off along with the place of environment education in terms of time and its assessment criteria. “It will require the development of locale-specific teacher, student and classroom material. Green textbooks, which are written from a holistic environmental perspective in terms of both their content and pedagogy. They should encourage flexibility to bring in locale specificities” (Position paper-National Focus Group on Habitat and Learning, NCF-2005).

In order to bring such paradigm, shift in the approach of teaching-learning, we need to critically reflect the way textbook writing is done. Teachers’ handbooks and manuals should provide access and comprehension to the teachers in terms of its content and organisation of various activities. Students' worksheets, charts and other innovating print, audio-video and latest digital teaching-learning materials will be helpful. This exercise can be done across the county in diverse contexts.

It is also important to note that the present syllabus is designed to develop an integrated understanding at the primary level that draws upon insights from sciences, social studies and environmental education. According to the document, 'Environment Education as Infused in NCERT syllabus for Classes I to XII as per NCF-2005' (National Curriculum Framework 2005) indicates some of the objectives of teaching science and social studies at the primary stage are as follows:

- to train children to locate and comprehend relationships among the natural, social and cultural environment;
- to create cognitive capacity and resourcefulness to make the child curious about social phenomena, starting with the family and moving on to wider spaces to nurture the curiosity and creativity of the child, particularly in relation to the natural environment (including artefacts and people);
- to develop an awareness about environmental issues;
- to engage the child in exploratory and hands-on activities to acquire basic cognitive and psychomotor skills through observation, classification, inference, and so on;
- to emphasise design and fabrication, and estimation and measurement as a prelude to the development of technological and quantitative skills in later stages; and
- to be able to critically address gender concerns, and issues of marginalisation and oppression with values of equality and justice, and respect for human dignity and rights.

Thus, environment education has been given much emphasis in our previous curriculum frameworks and official documents. Now there is a need to critically evaluate the effectiveness of work done so far, and develop a progressive, concrete and achievable framework for the implementation of environment education in letter and spirit.

Suggested Pedagogical Interventions

There are various pedagogical strategies through which parents, teachers and schools can develop environmental sensitivity, knowledge and awareness among students of various grades. These activities may be school-based or situated in the natural-social-community environment of the child. Various pedagogical strategies and teaching-learning materials which should be practiced to promote environment education in schools are:

(A) Teaching-Learning Material

i. Development of charts, posters, models, flip books, flannel boards on the theme of environment.

ii. Organisation of Slogan and Essay writing; and community campaigns for the environmental awareness.

iii. Conduct News article analysis, daily weather report analysis, worksheets, puzzles, crosswords, games and diverse activities on environmental awareness.

iv. Creation of e-library of environment related movies, videos, poems and books.

v. Development of school magazines on the theme of environment.

vi. Decoration of bulletin boards.

vii. Development of enrichment materials such as handbooks, modules, MOOCs for varied groups and needs.

(B) Activities and Pedagogical Strategies

i. Guiding students to conduct case studies on various environmental issues in their surroundings.

ii. Facilitate school-community collaboration on environmental issues and problems.

iii. Sharing latest news and updates about environmental issues and progress.

iv. Development of environment preservation as a cultural practice and value.

v. Adopting STSE (Science-Technology-Society-Environment) approach.

vi. Adopting scientific and progressive teaching approaches, such as investigation, problem-solving, process skill development, critical thinking and investigatory and issue-based project method.

vii. Creation of Eco Clubs and herbal gardens, and free sapling distribution in community.

viii. Encouraging students to design and develop home-based herbal gardens.

ix. Development of school as an ideal eco-friendly, self-sustainable system.

x. Encouraging home-based and traditional environment- friendly practices in everyday life.

xi. Celebration of environment-related special days in the school.

xii. Field visits.

xiii. Conducting workshops on various environmental preservation themes, such as creating organic fertilisers, vermicomposting, importance of ayurvedic practices and herbal medicines, yoga for healthy living.

xiv. Organising seminars and conferences on environment-related knowledge sharing.

xv. Organisation of Eco fair and exhibitions of nature-based products.

xvi. Teaching students about various research tools and surveys for the study of environment-related issues and problems.

xvii. Organisation of environment-related cultural programmes including various dance forms, role-plays, cultural songs, games, group discussions, debates and extempore speeches.

xviii. Bulletin board creation on environment-related themes.

xix. Placing the list of fundamental duties (environment protection) at various places in school.

xx. Developing schools and eco-friendly green schools' model, and conducting green audit to understand, learn and suggest the ways to improve the same.

xxi. Enrichment through inviting environment education specialists and community people as resource persons.

xxii. Discussion of latest eco-friendly practices across India and the world. (Example: organic farming, vermicomposting, farming on symbiotic relationships and the knowledge of differential nutrient requirement of various crops).

xxiii. Relationship between environment preservation and growth of economy and the nation.

xxiv. Use of digital media for sharing and validation of environment-related data collected by students.

xxv. Making blogs on Environment education for knowledge dissemination at mass level.

xxvi. Organising students' and teachers' inter-school, inter-state and international exchange meets to learn from each other.

xxvii. Organisation of competitions on the theme of environment at inter-school level for teachers and students.

SUGGESTED TEACHER EDUCATION REFORMS

Teachers are the key agents who will implement new environment education curriculum in schools and higher education. Therefore, it is very important to give due attention to desired changes in pre-service teacher education programmes, and in-service enrichment and training of teachers working in the field. A well-planned and rigorous work is required for the development of environment education curriculum in Teacher education programmes.

It is very important to develop appropriate attitude, skills and values among teachers to empower them to implement the key ideas of environment education in its real sense and perspective.

This can be done through proper curriculum planning and implementation of training programmes on both pre-service and in-service levels.

We also need to understand the unique nature of environment education as a subject. It has many concepts which may demand teachers to come out of their traditional subject boundaries and perceptions. This is also to understand that by nature, environment education has deep integration with science, social science and environment (natural and social both); and scientific concepts and ideas form a strong foundation of the subject. In this context, many teachers who might not have a sound understanding of the content and the nature of science, may find it difficult to understand the nature of environment education in its essence. It may prove to be a hurdle in the deeper construction of knowledge in environment education. Therefore, it is also crucial to integrate some of the fundamental key aspects of environment education curriculum. Some of the important topics which may be included are—

- problems of the environment, and the means and ways of solving them;

- environmental problems of physical, social and economic consequences;
- environmental problems on geographical scale and time scale;
- environmental problems of developed and developing countries;
- solutions of environmental problems;
- concept and nature of environment education;
- history and philosophy of environment education;
- national and international efforts in the field of environment education;
- integration of environment education from pre-primary till higher education curriculum and
- environmental ethics.

Here, it is also very important to understand that for an overall change in the approach towards environment education, not only teachers but other important stakeholders such as education officers, administrators, principals, headmasters and parents will also be required to be oriented and trained for the effective implementation of environment education. For this, training material for key resource persons will have to be prepared to facilitate in-service training of teachers of different stages of school education and different subject backgrounds.

The responsibility of identification of training is needed for different stakeholders and the development of training modules for them must be shouldered by eminent institutions like NCERT, SCERTs and professionals such as teacher educators, teachers, NGOs experts and other professionals of eminence in environment education from universities/colleges/research institutions.

CONCLUSION

Inculcation of environmental sensitivity, awareness, knowledge, skills, attitudes and values among the students, lies at cornerstone of achieving sustainable life on this planet Earth. Environment education is an urgent step that must lead a paradigm shift in education to promote the pursuit of sustainable development. A major shift that is required is the change of our mindset in perceiving education being a process of dialogue and mutual growth with students rather than monologue of transacting the information in one way from teacher to student. This change is possible not only with the change in curriculum and textbooks but also with the fundamental change in the conceptualisation of knowledge and teaching-learning in our schools. "The principles of ecology and fundamentals of environment can really help create a sense of earth-citizenship, and a sense of duty to care for the earth and its resources and to manage them in a sustainable way. This will make our children inherit a safe and clean planet to live on by social, ethical, global and spiritual values" (https://www.yourarticlelibrary.com/environment/the-need-of-value-based-environmental-education). Thus, it can be said that the main focus of environment education should be to help make students to relate with their real-life surroundings (natural and social both). They should be empowered with science process skills so that they feel confident in understanding and solving problems and concerns related to the environment. They should be able to not only create the new knowledge but should also be able to take positive actions to move towards sustainable development as well.

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9

Wild Vegetables and Fruits Utilised as Daily or Periodic Dietary Component of Scheduled Tribes Communities of India—An Exhibition

(A Collaborative Effort)

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Wild Vegetables and Fruits Used by Scheduled Tribes Communities (Adi, Aka, Galo, Khanpati, Mishmi, Momba, Sherdukpen, Singpho) of Arunachal Pradesh

Local name:
Kopi Pimik

Scientific name:
Solanum virgianum L.

Family:
Solanaceae

Local name:
Lori/Pipla

Scientific name:
Piper pedicellatum C.DC.

Family:
Piperaceae

Local name:
Marsang

Scientific name:
Blainvillea acmella (L.) Philipson

Family:
Asteraceae

Local name:
Oyik

Scientific name:
Gonostegia triandra (Blume) Miq.

Family:
Urticaceae

Local name:
Onger

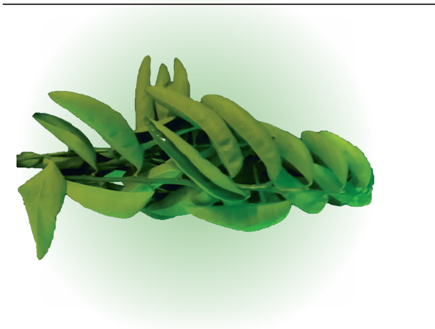
Scientific name:
Zanthoxylum rhetsa (Roxb.) DC.

Family:
Rutaceae

Local name:
Migom Kopi

Scientific name:
Solanum torvum Sw.

Family:
Solanaceae



Local name:
Gamm oying

Scientific name:
Breynia androgyna (L.) Chakrab.
& N.P.Balakr.

Family:
Phyllanthaceae

Local name:
Kasiang Kopi

Scientific name:
Solanum aethiopicum L.

Family:
Solanaceae

Local name:
Ongin

Scientific name:
Clerodendrum colebrookianum Walp.

Family:
Lamiaceae

Local name:
Oko Mamang

Scientific name:
Solanum nigrum L.

Family:
Solanaceae

Local name:
Kekir

Scientific name:
Zingiber sianginensis Tatum & Arup K.Das

Family:
Zingiberaceae

Wild Vegetables and Fruits Used by Scheduled Tribes Communities (Halba and Gond) of Chhattisgarh

Local name:
Bohar Bhaji

Scientific name:
Cordia dichotoma G.Forst.

Family:
Boraginaceae

Local name:
Kochai Pan

Scientific name:
Colocasia esculenta (L.) Schott.

Family:
Araceae

Local name:
Chantti bhaji

Scientific name:
Polygonum plebeium R.Br.

Family:
Polygonaceae

Local name:
Bhathua Bhaji

Scientific name:
Chenopodium album L.

Family:
Amaranthaceae

Local name:
Master Bhaji

Scientific name:
Talinum fruticosum (L.) Juss.

Family:
Talinaceae

Local name:
Koliari Bhaji

Scientific name:
Bauhinia racemosa Lam.

Family:
Fabaceae

Local name:
Bhokar Bhaji, Bohar Bhaji

Scientific name:
Cordia dichotoma G.Forst.

Family:
Boraginaceae

Local name:
Bhokar Bhaji, Bohar Bhaji

Scientific name:
Cordia dichotoma G.Forst.

Family:
Boraginaceae

Local name:
Awali Bhaji

Scientific name:
Oxalis hirta L.

Family:
Oxalidaceae

Local name:
Charota Bhaji

Scientific name:
Senna tora (L.) Roxb.

Family:
Fabaceae

Local name:
Chunchunia Bhaji

Scientific name:
Marsilea vestita Hook. & Grev.

Family:
Marsileaceae

Local name:
Gumee Bhaji

Scientific name:
Leucas cephalotes Spreng.

Family:
Lamiaceae

Local name:
Brahmi

Scientific name:
Centella asiatica (L.)Urb.

Family:
Apiaceae

Local name:
Hadjod

Scientific name:
Cissus quadrangularis L.

Family:
Vitaceae

Local name:
Karmota Bhaji

Scientific name:
Ipomoea aquatica Forssk.

Family:
Convolvulaceae

Local name:
Bans Karil

Scientific name:
Dendrocalamus strictus (Roxb.) Nees

Family:
Poaceae

Local name:
Safed Bhatheri

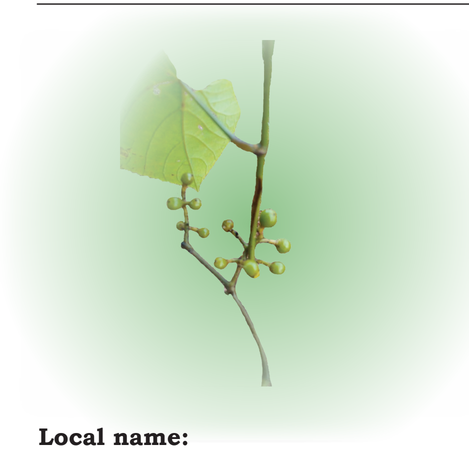
Scientific name:
Solanum violaceum Ortega

Family:
Solanceae

Local name:
Safed Bhatheri

Scientific name:
Solanum violaceum Ortega

Family:
Solanceae



Local name:
Peng Bhaji

Scientific name:
Celastrus paniculatus Willd.

Family:
Celastraceae

Local name:
Peng Bhaji

Scientific name:
Celastrus paniculatus Willd.

Family:
Celastraceae

Local name:
Jungli Pidi Kand

Scientific name:
Dioscorea oppositifolia L.

Family:
Dioscoreaceae

Local name:
Bhaisdhate Kanda

Scientific name:
Dioscorea alata L.

Family:
Dioscoreaceae

Local name:
Kochai kanda

Scientific name:
Colocasia esculenta (L.) Schott

Family:
Araceae

Local name:
Kochai Kanda

Scientific name:
Colocasia esculenta (L.) Schott

Family:
Araceae

Local name:
Semar Kanda

Scientific name:
Bombax ceiba L.

Family:
Malvaceae

Local name:
Kew Kand

Scientific name:
Hellenia speciosa (J. Koenig) S.R.Dutta

Family:
Costaceae

Local name:
Nangar Kanda

Scientific name:
Dioscorea alata L.

Family:
Dioscoreaceae

Local name:
Karu Kanda

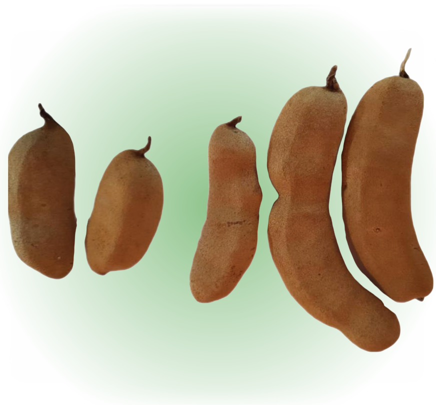
Scientific name:
Dioscorea pentaphylla L.

Family:
Dioscoreaceae

Local name:
Dangkanda
Scientific name:
Dioscorea bulbifera L.
Family:
Dioscoreaceae

Local name:
Ran Hald, Hardoli
Scientific name:
Curcuma aromatica Salisb.
Family:
Zingiberaceae

Local name:
Jirragoonda
Scientific name:
Hibiscus sabdariffa L.
Family:
Malvaceae



Local name:
Taitar, Hinta
Scientific name:
Tamarindus indica L.
Family:
Fabaceae

Local name:
Mahua

Scientific name:
Madhuca longifolia (L.) J.F.Macbr.

Family:
Sapotaceae

Local name:
Mahua

Scientific name:
Madhuca longifolia (L.) J.F.Macbr.

Family:
Sapotaceae

Local name:
Gular

Scientific name:
Ficus racemosa L.

Family:
Moraceae

Local name:
Gular

Scientific name:
Ficus racemosa L.

Family:
Moraceae

Local name:
Bedela Kachari

Scientific name:
Cucumis melo L.

Family:
Cucurbitaceae

Local name:
Tendu

Scientific name:
Diospyros melanoxylon Roxb.

Family:
Ebenaceae

Local name:
Hirva

Scientific name:
Macrotyloma uniflorum (Lam.) Verdc.

Family:
Fabaceae

Local name:
Hirva

Scientific name:
Macrotyloma uniflorum (Lam.) Verdc.

Family:
Fabaceae

Wild Vegetables and Fruits Used by Scheduled Tribes Communities (Gond and Bega) of Amarkantak, Madhya Pradesh

Local name:
Pihti

Scientific name:
Cucumis melo L.

Family:
Cucurbitaceae

Local name:
Batra Semi

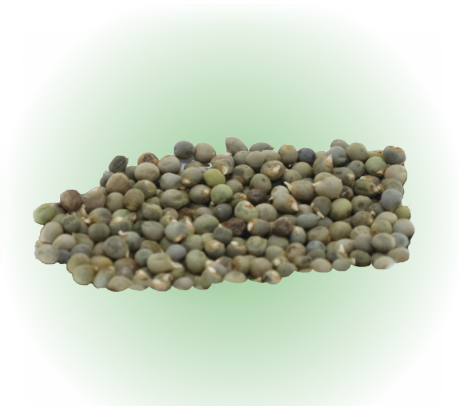
Scientific name:
Lablab purpureus (L.) Sweet

Family:
Fabaceae

Local name:
Barbati

Scientific name:
Vigna angularis (Willd.) Ohwi & H. Ohashi

Family:
Fabaceae



Local name:
Bhenda

Scientific name:
Abelmoschus ficulneus (L.) Wight & Arn.

Family:
Malvaceae

Local name:
Sahajan

Scientific name:
Moringa oleifera Lam.

Family:
Moringaceae

Local name:
Begani jeera

Scientific name:
Cuminum cyminum L.

Family:
Apiaceae

Local name:
Tikhur Kand

Scientific name:
Curcuma angustifolia Roxb.

Family:
Zingiberaceae

Local name:
Kachai Kand

Scientific name:
Colocasia esculenta (L.) Schott

Family:
Araceae

Local name:
Ratal Kand

Scientific name:
Dioscorea alata L.

Family:
Dioscoreaceae

Local name:
Daang Kand

Scientific name:
Dioscorea bulbifera L.

Family:
Dioscoreaceae

Local name:
Gathru Kand

Scientific name:
Dioscorea villosa L.

Family:
Dioscoreaceae

Local name:
Bechandi Kand

Scientific name:
Dioscorea hispida Dennst.

Family:
Dioscoreaceae

Local name:
Mandra Kand

Scientific name:
Amorphophallus paeoniifolius (Dennst.) Nicolson

Family:
Araceae

Local name:
Barahi Kand

Scientific name:
Dioscorea bulbifera L.

Family:
Dioscoreaceae

Local name:
Gaintha Kand

Scientific name:
Dioscorea belophylla (Prain) Voigt ex Haines

Family:
Dioscoreaceae

Local name:
Bhilwa

Scientific name:
Anacardium excelsum Skeels

Family:
Anacardiaceae

Wild Vegetables and Fruits Used by Scheduled Tribes Community (Konkan) of Baripada, Maharashtra

Local name:
Kurdu

Scientific name:
Celosia argentea L.

Family:
Amaranthaceae

Local name:
Nalgut

Scientific name:
Ipomoea aquatica Forssk.

Family:
Convolvulaceae

Local name:
Ova

Scientific name:
Trachyspermum ammi Sprague

Family:
Apiaceae

Local name:
Paan

Scientific name:
Colocasia esculenta (L.) Schott

Family:
Araceae

Local name:
Rajgira

Scientific name:
Amaranthus cruentus L.

Family:
Amaranthaceae

Local name:
Tarota

Scientific name:
Senna tora (L.) Roxb.

Family:
Fabaceae

Local name:
Makoi

Scientific name:
Solanum nigrum L.

Family:
Solanaceae

Local name:
Dampan

Scientific name:
Kalanchoe pinnata (Lam.) Pers.

Family:
Crassulaceae

Local name:
Ran Keli

Scientific name:
Ensete superbum (Roxb.) Cheesman

Family:
Musaceae

Local name:
Dhodada Kand

Scientific name:
Sauromatum venosum (Dryand. ex Aiton) Kunth

Family:
Araceae

Local name:
Kadavya Halunda

Scientific name:
Vigna vexillata (L.) A.Rich.

Family:
Fabaceae

Local name:
Kadu Kand

Scientific name:
Dioscorea bulbifera L.

Family:
Dioscoreaceae

Local name:
Alu Kanda

Scientific name:
Dioscorea esculenta (Lour.) Burkill

Family:
Dioscoreaceae

Local name:
Bafli Kand

Scientific name:
Tetrataenium grande (Dalzell & A.Gibson) Manden.

Family:
Apiaceae

Local name:
Devari Goyalchi

Scientific name:
Dioscorea alata L.

Family:
Dioscoreaceae

Local name:
Ulshi Kand

Scientific name:
Dioscorea hispida Dennst.

Family:
Dioscoreaceae

Local name:
Udadya Atum Halund

Scientific name:
Curcuma pseudomontana J.Graham

Family:
Zingiberaceae

Local name:
Udla

Scientific name:
Gynura bicolor (Roxb. ex Willd.) DC.

Family:
Asteraceae

Local name:
Tera Kand

Scientific name:
Colocasia esculenta (L.) Schott

Family:
Araceae

Local name:
Ranaltulas Mul

Scientific name:
Ocimum gratissimum (L.)

Family:
Lamiaceae

Local name:
Shevra Mul

Scientific name:
Asparagus racemosus Willd.

Family:
Asparagaceae

Local name:
Sonaru

Scientific name:
Achyranthes aspera L.

Family:
Amaranthaceae

Wild Vegetables and Fruits Used by Scheduled Tribes Community (Gond) of Gadchiroli, Maharashtra

Local name:
Mataru

Scientific name:
Dioscorea bulbifera L.

Family:
Dioscoreaceae

Local name:
Ran Hald, Hardoli

Scientific name:
Curcuma aromatica Salisb.

Family:
Zingiberaceae

Local name:
Alu Dhopa

Scientific name:
Colocasia esculenta (L.) Schott

Family:
Araceae

Local name:
Suran

Scientific name:
Amorphophallus paeoniifolius
(Dennst.) Nicolson

Family:
Araceae

Local name:
Charoli/Chironji

Scientific name:
Buchanania cochinchinensis (Lour.) M.R.Almeida

Family:
Anacardiaceae

Local name:
Momnaru

Scientific name:
Dioscorea esculenta (Lour.) Burkill

Family:
Dioscoreaceae

Wild Vegetables and Fruits Used by Scheduled Tribes Communities (Warli and Mahadev Koli) of Jawhar, Maharashtra

Local name:
Gometo

Scientific name:
Solena amplexicaulis (Lam.) Gandhi

Family:
Cucurbitaceae

Local name:
Kartule

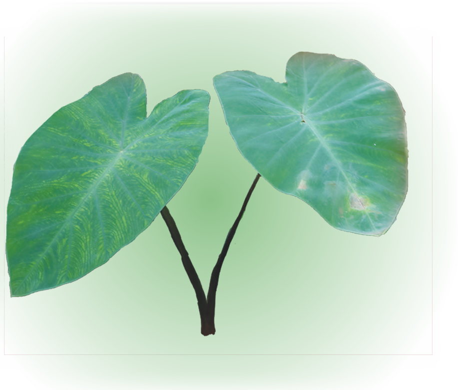
Scientific name:
Momordica dioica Roxb. ex Willd.

Family:
Cucurbitaceae

Local name:
Vaaste

Scientific name:
Bambusa bambos (L.) Voss

Family:
Poaceae



Local name:
Alu

Scientific name:
Colocasia esculenta (L.) Schott

Family:
Araceae

Local name:
Baafali

Scientific name:
Tetrataenium grande (Dalzell & A. Gibson) Manden.

Family:
Apiaceae

Local name:
Bahaawaa

Scientific name:
Cassia fistula L.

Family:
Fabaceae

Local name:
Sanbal

Scientific name:
Amaranthus roxburghianus H.W.Kung

Family:
Amaranthaceae

Local name:
Petar

Scientific name:
Mallotus polycarpus (Benth.) Kulju & Welzen

Family:
Euphorbiaceae

Local name:
Dongar Jeera

Scientific name:
Pimpinella heyneana (DC.) Kurz

Family:
Apiaceae

Local name:
Kadi Kaula

Scientific name:
Smithia conferta Sm.

Family:
Fabaceae

Local name:
Kakad

Scientific name:
Garuga pinnata Roxb.

Family:
Burseraceae

Local name:
Kala Kuda

Scientific name:
Wrightia tinctoria R.Br.

Family:
Apocynaceae

Local name:
Karvand

Scientific name:
Carissa carandas L.

Family:
Apocynaceae

Local name:
Karvand

Scientific name:
Carissa carandas L.

Family:
Apocynaceae

Local name:
Kawadar

Scientific name:
Ensete superbum (Roxb.) Cheesman

Family:
Musaceae

Local name:
Keni

Scientific name:
Commelina diffusa Burm. f.

Family:
Commelinaceae

Local name:
Kher-sheng

Scientific name:
Radermachera xylocarpa (Roxb.) Roxb. ex K.Schum.

Family:
Bignoniaceae

Local name:
Kohrul

Scientific name:
Bauhinia racemosa Lam.

Family:
Fabaceae

Local name:
Kauvali Bhaaji

Scientific name:
Chlorophytum borivilianum Santapau & R.R.Fern.

Family:
Asparagaceae

Local name:
Kurdu

Scientific name:
Celosia argentea L.

Family:
Amaranthaceae

Local name:
Lothi

Scientific name:
Dioscorea pentaphylla L.

Family:
Dioscoreaceae

Local name:
Mek

Scientific name:
Cucumis setosus Cogn.

Family:
Cucurbitaceae

Local name:
Moh

Scientific name:
Madhuca longifolia (L.) J.F.Macbr.

Family:
Sapotaceae

Local name:
Mokha

Scientific name:
Schrebera swietenioides Roxb.

Family:
Oleaceae

Local name:
Paayar

Scientific name:
Ficus arnottiana (Miq.) Miq.

Family:
Moraceae

Local name:
Paayar

Scientific name:
Ficus arnottiana (Miq.) Miq.

Family:
Moraceae

Local name:
Pendhara

Scientific name:
Tamilnadia uliginosa (Retz.) Tirveng. & Sastre

Family:
Rubiaceae

Local name:
Pendhara

Scientific name:
Tamilnadia uliginosa (Retz.) Tirveng. & Sastre

Family:
Rubiaceae

Local name:
Sapud

Scientific name:
Leea asiatica (L.) Ridsdale

Family:
Vitaceae

Local name:
Shiri

Scientific name:
Cynanchum annularium (Roxb.) Liede & Khanum

Family:
Apocynaceae

Local name:
Taag

Scientific name:
Crotalaria juncea L.

Family:
Fabaceae

Local name:
Tandlya

Scientific name:
Alternanthera sessilis (L.) DC.

Family:
Amaranthaceae

Local name:
Temburni

Scientific name:
Diospyros melanoxylon Roxb.

Family:
Ebenaceae

Local name:
Terda

Scientific name:
Impatiens balsamina L.

Family:
Balsaminaceae

Local name:
Tetu

Scientific name:
Oroxylum indicum (L.) Kurz

Family:
Bignoniaceae

Local name:
Toran

Scientific name:
Ziziphus rugosa Lam.

Family:
Rhamnaceae

Local name:
Umbar

Scientific name:
Ficus racamosa L.

Family:
Moraceae

Local name:
Vagheti

Scientific name:
Capparis zeylanica L.

Family:
Capparaceae

Local name:
Aliv

Scientific name:
Meyna laxiflora Robyns

Family:
Rubiaceae

Local name:
Aliv

Scientific name:
Meyna laxiflora Robyns

Family:
Rubiaceae

Local name:
Chai vel (Ulshi)

Scientific name:
Dioscorea pentaphylla

Family:
Dioscoreaceae

Local name:
Bhokar

Scientific name:
Cordia dichotoma G.Forst.

Family:
Boraginaceae

Local name:
Akkarghoda

Scientific name:
Pteridium aquilinum (L.) Kuhn

Family:
Dennstaedtiaceae

Local name:
Kukulval

Scientific name:
Sterculia guttata Roxb.

Family:
Malvaceae

Wild Vegetables and Fruits Used by Scheduled Tribes Community (Korku) of Melghat, Maharashtra

Local name:
Sada Phuli

Scientific name:
Catharanthus roseus (L.) G.Don

Family:
Apocynaceae

Local name:
Bhumi Amla

Scientific name:
Phyllanthus niruri L.

Family:
Phyllanthaceae

Local name:
Ambuta

Scientific name:
Oxalis corniculata L.

Family:
Oxalidaceae

Local name:
Panfuti

Scientific name:
Kalanchoe daigremontiana Raym.-Hamet & H. Perrier

Family:
Crassulaceae

Local name:
Gulabas

Scientific name:
Mirabilis jalapa L.

Family:
Nyctaginaceae

Local name:
Karadkhosla

Scientific name:
Amaranthus spinosus L.

Family:
Amaranthaceae

Local name:
Hirva Umber

Scientific name:
Ficus racemosa L.

Family:
Moraceae

Local name:
Chuch Bhaji

Scientific name:
Corchorus olitorius L.

Family:
Malvaceae

Wild Vegetables and Fruits Used by Scheduled Tribes Community (Bhil) of Nandurbar, Maharashtra

Local name:
Pendre

Scientific name:
Tamilnadia uliginosa (Retz.) Tirveng. & Sastre

Family:
Rubiaceae

Local name:
Dharvda

Scientific name:
Lagerstroemia parviflora Roxb.

Family:
Lythraceae

Local name:
Denimogro

Scientific name:
Diospyros melanoxylon Roxb.

Family:
Ebenaceae

Local name:
Kachanar

Scientific name:
Bauhinia purpurea L.

Family:
Fabaceae

Local name:
Aahlu, Kaasaalu

Scientific name:
Alocasia macrorrhizos (L.) G.Don

Family:
Araceae

Local name:
Akhivda

Scientific name:
Celosia argentea L.

Family:
Amaranthaceae

Local name:
Ghevda

Scientific name:
Lablab purpureus (L.) Sweet subsp. *purpureus*

Family:
Fabaceae

Local name:
Imli

Scientific name:
Tamarindus indica L.

Family:
Fabaceae

Local name:
Gathyo

Scientific name:
Alternanthera sessilis (L.) DC.

Family:
Amaranthaceae

Local name:
Helto (Phalsa)

Scientific name:
Grewia asiatica L.

Family:
Malvaceae

Local name:
Kena

Scientific name:
Commelina benghalensis L.

Family:
Commelinaceae

Local name:
Koalya

Scientific name:
Bambusa bambos (L.) Voss

Family:
Poaceae

Local name:
Kotlo

Scientific name:
Momordica dioica Roxb. ex Willd.

Family:
Cucurbitaceae

Local name:
Malkangni

Scientific name:
Celastrus paniculatus Willd.

Family:
Celastraceae

Local name:
Meke

Scientific name:
Cucumis setosus Cogn.

Family:
Cucurbitaceae

Local name:
Pebdo

Scientific name:
Amorphophallus konjac K.Koch

Family:
Araceae

Local name:
Povjyapajo

Scientific name:
Pupalia lappacea (L.) Juss.

Family:
Amaranthaceae

Local name:
Rankeli

Scientific name:
Ensete superbum (Roxb.) Cheesman

Family:
Musaceae

Local name:
Silo

Scientific name:
Marsilea minuta L.

Family:
Marsileaceae

Local name:
Tenbro

Scientific name:
Diospyros melanoxylon Roxb.

Family:
Ebenaceae

Wild Vegetables and Fruits Used by Scheduled Tribes Communities (Thakre and Mahadev Koli) of Sangamner, Maharashtra

Local name:
Alu Taro

Scientific name:
Colocasia esculenta (L.) Schott

Family:
Araceae

Local name:
Bhalavand

Scientific name:
Dillenia pentagyna Roxb.

Family:
Dilleniaceae

Local name:
Jambhul

Scientific name:
Syzygium cumini (L.) Skeels

Family:
Myrtaceae

Local name:
Karatule

Scientific name:
Momordica dioica Roxb. ex Willd.

Family:
Cucurbitaceae

Local name:
Kavanda

Scientific name:
Carissa spinarum L.

Family:
Apocynaceae

Local name:
Moh

Scientific name:
Madhuca longifolia (L.) J.F.Macbr.

Family:
Sapotaceae

Local name:
Panfuti

Scientific name:
Kalanchoe pinnata (Lam.) Pers.

Family:
Crassulaceae

Local name:
Rukhalu

Scientific name:
Remusatia vivipara (Roxb.) Schott

Family:
Araceae

Local name:
Savar

Scientific name:
Bombax ceiba L.

Family:
Malvaceae

Local name:
Umbar

Scientific name:
Ficus racemosa L.

Family:
Moraceae

Local name:
Dhayati

Scientific name:
Woodfordia fruticosa Kurz

Family:
Lythraceae

Local name:
Wild Mango

Scientific name:
Irvingia gabonensis (Aubry-Lecomte ex O'Rohke) Baill.

Family:
Irvingiaceae

Wild Vegetables and Fruits Used by Scheduled Tribes Communities of Manipur

Local name:
Heiba mana

Scientific name:
Exbucklandia populnea (R.Br. ex Griff.) R.W.Br.

Family:
Hamamelidaceae

Local name:
Komprek

Scientific name:
Oenanthe javanica DC.

Family:
Apiaceae

Local name:
Loklei

Scientific name:
Hedychium ellipticum Buch.-Ham. ex Sm.

Family:
Zingiberaceae

Local name:
Lomba

Scientific name:
Elsholtzia blanda Benth.

Family:
Lamiaceae

Local name:
Maroi napakpi

Scientific name:
Allium hookeri Thwaites

Family:
Amaryllidaceae

Local name:
Monjaobi

Scientific name:
Chenopodium album L.

Family:
Amaranthaceae

Local name:
Nongmangkha mapan

Scientific name:
Phlogacanthus thyrsiformis (Roxb. ex Hardw.) Mabb.

Family:
Acanthaceae

Local name:
Peruk

Scientific name:
Centella asiatica (L.)Urb.

Family:
Apiaceae

Local name:
Phakpai

Scientific name:
Polygonum posumbu Buch.-Ham. ex D.Don

Family:
Polygonaceae

Local name:
Maroi nakuppi

Scientific name:
Allium ampeloprasum L.

Family:
Amaryllidaceae

Local name:
Thambou

Scientific name:
Nelumbo nucifera Gaertn.

Family:
Nelumbonaceae

Local name:
Sougri

Scientific name:
Hibiscus sabdariffa L.

Family:
Malvaceae

Local name:
Toningkhok

Scientific name:
Houttuynia cordata Thunb.

Family:
Saururaceae

Local name:
Thamna makon

Scientific name:
Nelumbo nucifera Gaertn.

Family:
Nelumbonaceae

Local name:
U morok

Scientific name:
Capsicum chinense Jacq.

Family:
Solanaceae

Local name:
Yellang

Scientific name:
Persicaria barbata (L.) Hara

Family:
Polygonaceae

Wild Vegetables and Fruits Used by Scheduled Tribes Communities of Meghalaya

Local name:
Chayote

Scientific name:
Sicyos edulis Jacq.

Family:
Cucurbitaceae

Local name:
Elephant apple

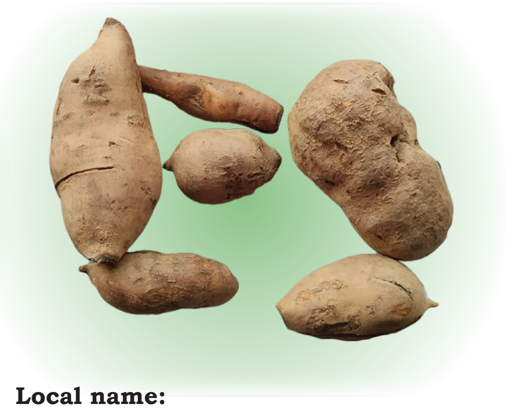
Scientific name:
Dillenia indica L.

Family:
Dilleniaceae

Local name:
Khasi Cherry

Scientific name:
Prunus napaulensis (Ser.) Steud.

Family:
Rosaceae



Local name:
Ground Apple

Scientific name:
Smallanthus sonchifolius (Poepp.) H.Rob.

Family:
Asteraceae

Wild Vegetables and Fruits Used by Scheduled Tribes Communities of Mizoram

Local name:
Dragon fruit

Scientific name:
Selenicereus undatus (Haw.) D.R.Hunt

Family:
Cactaceae

Local name:
Dragon fruit

Scientific name:
Selenicereus undatus (Haw.) D.R.Hunt

Family:
Cactaceae

Local name:
Dragon fruit

Scientific name:
Selenicereus undatus (Haw.) D.R.Hunt

Family:
Cactaceae

Local name:
Dragon fruit

Scientific name:
Selenicereus undatus (Haw.) D.R.Hunt

Family:
Cactaceae

Local name:
Sarzuk

Scientific name:
Elaeagnus latifolia L.

Family:
Elaeagnaceae

Local name:
Chilto

Scientific name:
Solanum betaceum Cav.

Family:
Solanceae

Local name:
Hruizik

Scientific name:
Calamus erectus Roxb.

Family:
Arecaceae

Local name:
Hruizik

Scientific name:
Calamus erectus Roxb.

Family:
Arecaceae

Local name:
Samtawk

Scientific name:
Solanum aethiopicum L.

Family:
Solanaceae

Local name:
Bitter Brinjal or Tomato

Scientific name:
Solanum incanum L.

Family:
Solanaceae

Local name:
Cowa fruit

Scientific name:
Garcinia cowa Roxb.

Family:
Clusiaceae

Local name:
Kawlbahra

Scientific name:
Ipomoea batatas (L.) Lam.

Family:
Convolvulaceae

Local name:
Purun

Scientific name:
Allium fistulosum L.

Family:
Amaryllidaceae

Local name:
Zawangtha

Scientific name:
Parkia speciosa Hassk.

Family:
Fabaceae

Local name:
Avocado

Scientific name:
Persea americana Mill.

Family:
Lauraceae

Local name:
Chow Chow

Scientific name:
Sicyos edulis Jacq.

Family:
Curcurbitaceae

Wild Vegetables and Fruits Used by Scheduled Tribes Communities (Bhil and Garasia Bhil of Jhadol phalasia) of Rajasthan

Local name:
Bathali

Scientific name:
Dysphania ambrosioides (L.) Mosyakin & Clemants

Family:
Amaranthaceae

Local name:
Kantakari

Scientific name:
Solanum virgianum L.

Family:
Solanaceae

Local name:
Safed Kaddu

Scientific name:
Benincasa hispida Cogn.

Family:
Cucurbitaceae

Local name:
Shivalingi (Karit)

Scientific name:
Diplocyclos palmatus. (L.) C.Jeffrey

Family:
Cucurbitaceae

Local name:
Hasti kand

Scientific name:
Leea macrophylla Roxb. ex Hornem.

Family:
Vitaceae

Local name:
Kali haldi

Scientific name:
Curcuma caesia Roxb.

Family:
Zingiberaceae

Local name:
Mirchi kand

Scientific name:
Corallocarpus epigaeus (Rottler) Hook.f.

Family:
Cucurbitaceae

Local name:
Balam Kheera

Scientific name:
Kigelia africana (Lam.) Benth.

Family:
Bignoniaceae

Local name:
Bilb

Scientific name:
Aegle marmelos (L.) Corrêa

Family:
Rutaceae

Local name:
Ber

Scientific name:
Ziziphus nummularia (Burm. f.) Wight & Arn.

Family:
Rhamnaceae

Local name:
Khajur

Scientific name:
Phoenix dactylifera L.

Family:
Arecaceae

Local name:
Khajur

Scientific name:
Phoenix dactylifera L.

Family:
Arecaceae

Wild Vegetables and Fruits Used by Scheduled Tribes Communities of Sikkim

Local name:
Amile ghans

Scientific name:
Rumex acetosa L.

Family:
Polygonaceae

Local name:
Chayote

Scientific name:
Sicyos edulis Jacq.

Family:
Cucurbitaceae

Local name:
Chinde saag

Scientific name:
Macropanax dispermus (Blume) Kuntze

Family:
Araliaceae

Local name:
Lapsi

Scientific name:
Spondias mombin L.

Family:
Anacardiaceae

Local name:
Gandey jhaar

Scientific name:
Houttuynia cordata Thunb.

Family:
Saururaceae

Local name:
Fruits of Mael

Scientific name:
Docynia indica (Colebr.) Decne.

Family:
Rosaceae

Local name:
Jangli dhania

Scientific name:
Eryngium foetidoum L.

Family:
Apiaceae

Local name:
Simrai Saag

Scientific name:
Nasturtium officinale R.Br.

Family:
Brassicaceae

Local name:
Nakima

Scientific name:
Tupistra nutans Wall. ex Lindl.

Family:
Asparagaceae

Local name:
Nakima

Scientific name:
Tupistra nutans Wall. ex Lindl.

Family:
Asparagaceae

Local name:
Ningroo

Scientific name:
Diplazium esculentum (Retz.) Sw.

Family:
Athyriaceae

Local name:
Ningroo

Scientific name:
Diplazium esculentum (Retz.) Sw.

Family:
Athyriaceae

Local name:
Sisnoo

Scientific name:
Urtica dioica L.

Family:
Urticaceae

Local name:
Tusa

Scientific name:
Dendrocalamus hamiltonii Nees & Arn. ex Munro

Family:
Poaceae

Local name:
Tusa (Sliced bamboo shoot)

Scientific name:
Dendrocalamus hamiltonii Nees & Arn. ex Munro

Family:
Poaceae

Local name:
Tusa (Dried bamboo shoot)

Scientific name:
Dendrocalamus hamiltonii Nees & Arn. ex Munro

Family:
Poaceae

Wild Vegetables and Fruits Used by Scheduled Tribes Communities of Uttarakhand

Local name:
Daru haldi

Scientific name:
Berberis aristata DC.

Family:
Berberidaceae

Local name:
Kingod

Scientific name:
Berberis aristata DC.

Family:
Berberidaceae

Local name:
Semal

Scientific name:
Bombax ceiba L.

Family:
Malvaceae

Local name:
Lingad or Lingru

Scientific name:
*Diplazium esculentum (*Retz.) Sw.

Family:
Athyriaceae

Local name:
Timla

Scientific name:
Ficus auriculata Lour.

Family:
Moraceae

Local name:
Timla

Scientific name:
Ficus auriculata Lour.

Family:
Moraceae

Local name:
Ban ka fal

Scientific name:
Fragaria vesca nubicola L.

Family:
Rosaceae

Local name:
Bichu buti

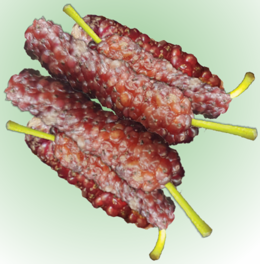
Scientific name:
Girardinia diversifolia (Link) Friis

Family:
Urticaceae

Local name:
Shahtut

Scientific name:
Morus alba L.

Family:
Moraceae



Local name:
Shahtut

Scientific name:
Morus alba L.

Family:
Moraceae

Local name:
Kafal

Scientific name:
Myrica esculenta
Buch.-Ham. ex D.Don

Family:
Myricaceae

Local name:
Ghingaru

Scientific name:
Pyracantha crenulata (D.Don)
M.Roem.

Family:
Rosaceae

Local name:
Mehal

Scientific name:
Pyrus pashia Buch.-Ham. ex D.Don

Family:
Rosaceae

Local name:
Buransh

Scientific name:
Rhododendron arboreum Sm.

Family:
Ericaceae

Local name:
Hinsar

Scientific name:
Rubus ellipticus Sm.

Family:
Rosaceae

Local name:
Hinsalu

Scientific name:
Rubus niveus Thunb.

Family:
Rosaceae

Local name:
Amildu

Scientific name:
Rumex hastatus D.Don

Family:
Polygonaceae

Local name:
Ideesh

Scientific name:
Viburnum lantana L.

Family:
Viburnaceae

Local name:
Ber

Scientific name:
Ziziphus oxyphylla Edgew.

Family:
Rhamnaceae

Local name:
Bael

Scientific name:
Aegle marmelos (L.) corrêa

Family:
Rutaceae

Local name:
Blue Berries

Scientific name:
Vaccinium corymbosum L.

Family:
Ericaceae

Local name:
Kiphaliya

Scientific name:
Duchesnea indica (Andrews) Teschem.

Family:
Rosaceae

Local name:
Sakina

Scientific name:
Indigofera heterantha Wall. ex Brandis

Family:
Fabaceae

Local name:
Bhamore

Scientific name:
Cornus capitata Wall.

Family:
Cornaceae

10 CONTEMPLATIONS FOR EXPANDING CURRICULAR INSIGHTS FROM COMMUNITY DIALOGUE: IN LIGHT OF NATIONAL EDUCATION POLICY 2020 PERSPECTIVES AND WAY FORWARD

Sunita Farkya*

INTRODUCTION

Since time immemorial, nature has been a great source of sustenance, growth and learning for the humankind. Ancient humans were always close to the nature and existed in sync with nature and its various resources. All the plants which existed in nature were in their original forms and propagated through natural means of pollination and seed dispersal without any kind of external anthropocentric action or human interference. These varieties of plants are known as wild plants. Therefore, wild vegetables and plants are those vegetables and plants which have never been cultivated nor been domesticated; but have been used as important sources of food, fibre and shelter by human beings since ages.

Even in present Indian territory, there are various tribal belts and geographical areas that exhibit examples of existence of an organic symbiotic association with nature. The long and close proximity with nature has equipped them with rich practical experiences and indigenous knowledge systems. This practical, indigenous, first-

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hand knowledge has also helped them devise various mechanisms and practices to optimally utilise various plant species and their varied products in diverse unique ways. Here, it is also important to note that along with various other usage, these wild, indigenous plant varieties and their products have also been a great source of various ethno-medicines for the local scheduled tribe communities. These have served on their primary health care system, and have helped them save themselves from various health issues and ailments with no added market cost from outside.

As a result of their long-term association and everyday conscious or unconscious observations of the nature, different tribal communities have evolved an immensely rich knowledge of local, wild vegetables and plants found in their surroundings. This traditional knowledge is an integral part of their personal, social, cultural and economic identity and is unique to every culture or community with oral communication being the primary mode of sharing the knowledge from one generation to other. The tribal community has always generated, refined and passed on the knowledge verbally across the generations, but in absence of proper documentation, there is a constant fear of losing this rich traditional knowledge forever.

Today, world stands on a juncture where old, experience-based, practical indigenous knowledge is being replaced by the dominance of 'modern' and formal institutional knowledge and thoughts. Various researches are revealing that personal, socio-cultural and traditional indigenous knowledge of children are not getting due importance and yet the 'western modern science' dominates the classroom discourse. As a result the tendency of our students not realising the significance and potential of their own indigenous knowledge has also been evolved. It is therefore, important, relevant and pertinent to not only revisit, cherish, celebrate and preserve our own indigenous knowledge system(s) and practices but also to visualise and carve out a path for more sustainable and inclusive agricultural practices and wider knowledge sharing with a strong sense of pride and belief in our own logic and evidence-based indigenous knowledge systems. This will help us realise our dream of a healthy, sustainable, self-sustained and progressive Bharat.

RATIONALE IN NATIONAL EDUCATION POLICY 2020 PERSPECTIVES

The commitment to go back to our roots and create a future of our own strengths becomes all the more important in context of our latest education policy, i.e., National Education Policy-2020. The policy lays strong emphasis on realising the importance of and taking pride in our own knowledge system; and to come out strongly from long etched colonial historical roots in collective Indian psyche. Thus, this is quintessential to not only generate a dialogue among the wider stakeholders from diverse sections of our society but also to conceptualise and develop an inclusive curricular framework which introduces and developes a deeper, critical understanding of our traditional knowledge systems.

As the NEP 2020, also recommends in the Para 4.27, 'Knowledge of India' to be included in school curriculum. It will include knowledge from ancient India and its contributions to modern India and its successes and challenges, and a clear sense of India's future aspirations with regard to education, health, environment, etc. These elements will be incorporated in an accurate and scientific manner throughout the school curriculum wherever relevant; in particular, Indian Knowledge Systems, including tribal knowledge and indigenous and traditional ways of learning, will be covered and included in mathematics, astronomy, philosophy, yoga, architecture, medicine, agriculture, engineering, linguistics, literature, sports, games, as well as in governance, polity and conservation. Specific courses in tribal ethno-medicinal practices, forest management, traditional (organic) crop cultivation, natural farming, etc. will also be made available.

Keeping the above discussed critical discourse in mind, a two-day interactive meet of educationists, scientists and community has been conceptualised to create a platform, which not only helps in formal institutionalised knowledge sharing but also facilitates informal dialogues and knowledge construction among various stakeholders from diverse fields. For this, efforts were made to bring on board the representatives from various domains, such as scientists, doctors and academicians working in formal institutions, and community representatives and educationists who are active in related knowledge transaction and sharing among wider masses. Independent scholars who are passionate about the field, have also been included for indigenous knowledge sharing.

PURPOSE OF THE NATIONAL INTERACTIVE MEET

This interactive meet was expected to meet following objectives:

- to provide an opportunity for an interaction and exchange of ideas related to indigenous knowledge between stakeholders from diverse fields;
- to trace the possible inter-linkages between Indigenous Knowledge systems with reference to wild plants and vegetables and ancient medicinal system of Ayurveda;
- to spread awareness about saving precious heritage of Indigenous Knowledge of wild plants and vegetables;
- to orient the wider masses towards biodiversity conservation;
- to create a collaborative network of educationists, scientists and communities, for exchange of ideas on Indigenous Knowledge in wild plants and vegetables; and
- to develop a vision and conceptualise a curricular framework to integrate the Indigenous Knowledge of wild plants and vegetables and their conservation in the present education system.

EXPECTED OUTCOMES FROM THE NATIONAL INTERACTIVE MEET

The following expected outcomes were drawn from the event:

i. A focus on community participation in indigenous knowledge sharing with an emphasis on wild plants and vegetables utilised by scheduled tribe community and their *in situ* conservation was discussed.

ii. Linkages between Indigenous Knowledge of wild plants and vegetables with Ayurveda was discussed.

iii. Environmental awareness for biodiversity conservation and saving of precious heritage of Indigenous Knowledge in wild plants and vegetables was discussed.

iv. A network of educationists, scientists and communities with reference to exchange of ideas on Indigenous Knowledge of wild plants and vegetables has been created.

v. A vision on integrating Indigenous Knowledge of wild plants and vegetables in the present education system has been discussed.

CURRICULAR INSIGHTS

The event provided insights for holistic learning of a learner under the informal and non-formal education scenario. They inadvertently go through the science process skills, such as observation, investigation, analysis and inference and so on as they see intricacies of changing nature with weather conditions and other factors, and connect them with their observations. While going to jungle with elders children learn various concepts such as identifying plants, their medicinal uses and their *in situ* conservation and more gradually and holistically. Many other science concepts they learn are related to biodiversity, conservation of biodiversity, values, ethics and environmental concerns that are inbuilt in the learning process. Overall the informal and non-formal learning takes place in a social scenario and they learn from elders and discuss with peers about their own learning.

The informal and non-formal learning addresses diversity of learners and learning process with age appropriateness, and provides experiential learning with ethics, respect to elders, with evidence. Elders while sharing life lessons and past experiences also address the historical evidences. Oral communication is one of the important pedagogies in this sharing of experiences. This also addresses environmental perspectives and respect to the environment.

The learning also provides mathematical perspectives, such as how much product is required, how much is available and how much will be consumed by what time; such kind of calculations. All the learning takes place under the social scenario in varied situations may it be a festivity, culture, rituals and so on. When it relates to livelihood, it also gives economic perspectives.

Since oral communication is one of the important pedagogy, language perspective is also addressed. It is very important to mention here that tribal languages are full of primitive words that came into existence due to characters. This is the reason why meaning of that particular word is being conveyed in true spirit. Since many of the tribal languages are vanishing fast, it is important to revive and conserve these languages by bringing them in curriculum for optimising learning (UNESCO, 2020).

Overall the seventeen sustainable development goals (United Nations, 2015) may be addressed by integrating the informal and non-formal education into formal education. Gender concerns are also addressed as there were a good number of female participants in the event and they came forward to participate and share their experiences.

Pedagogy and Content Redressal

The event has provided insights for high pedagogical implications of this indigenous knowledge. It suggests proper integration of informal, non-formal and formal education for addressing diversity of learners. It will bridge the gaps of diverse social scenario making learning inadvertent and easy. Following are some pedagogical inputs suggested during the event:

i. Bringing community to school for competency and skills development, teachers along with community resource persons may initiate discussion with learners in classroom or school premises.

ii. Working with community on the given topics such as forest produce of different regions of India, wild vegetables and fruits, wild vegetables and fruits in different weathers, weather conditions for flowering and fruiting of wild vegetables, factors affecting pollination of wild edibles, medicinal importance of wild edibles, recipes to eliminate toxins from wild edibles for its effective use as medicine, etc.

iii. Community campaigns for awareness about modern science and applications, such as nutraceuticals values of ethnomedicines, etc.

iv. Cultural exchange programmes for *in situ* learning by staying with community for a week or more and learn about socio-economic and socio-cultural facets, language, environment, ethics, health and hygiene, etc.

Implementation

i. A Community Resource Group may be formed by identifying experts from each and every scheduled tribe community of India.

ii. All the members of Community Resource Group may be registered with the state education department for content delivery related to the concerned indigenous knowledge of that particular area.

iii. A skilled person from scheduled tribes community may be invited to act as a resource person for pedagogical inputs for contextual curriculum delivery. This will address the gaps related to language and cultural context.

iv. Identification of content in each curricular area by the subject experts and teachers to relate with the indigenous knowledge for knowledge transaction and pedagogy.

v. Teacher development and orientation programmes must include sessions for implementation and integration of informal, non-formal and formal education for optimising learning.

CONCLUSION

The approach of formation of Community Resource Groups will definitely boost-up the confidence of community. They would feel pride in their own knowledge skills and strengths they earned after a long experience. Running behind one profession for livelihood will be addressed to some extent by this approach. The learners in context and otherwise would become self-sufficient in their own indigenous knowledge and skills. They will relate it with the modern knowledge and develop the competency for entrepreneurial development. It will proceed towards a community led curriculum for self-sufficient and self-reliant India.

The interactive meet also provided avenues for modern methods of researches not only to revalidate the knowledge but also for further applications and insights for new fields and researches, such as nutraceuticals researches have provided insights on nutritional importance of wild edibles.

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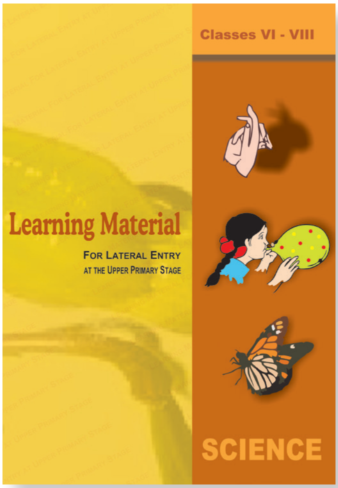

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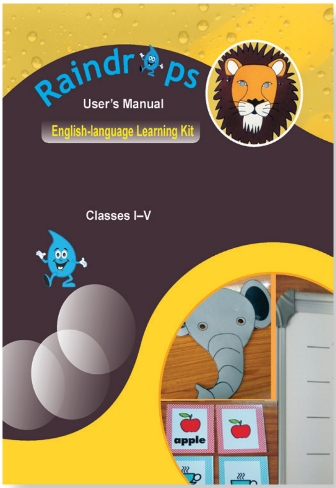

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