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Medicinal Knowledge in South India (During Neolithic to Early Historic Period): An Analysis of Staple Plant Dietary Nutrition

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ABSTRACT

This study explores the dietary habits and potential medicinal knowledge of prehistoric South Indian communities through archaeobotanical analysis. It traces the transition from hunter-gatherer diets to agriculturally based diets, focusing on staple crops like pulses, millets, and cereals. The research highlights the nutritional and nutraceutical benefits of these crops, including their roles in providing protein, fibre, and essential fats, as well as their antioxidant, antimicrobial, and anticarcinogenic properties. The paper also examines the impact of food processing techniques such as sprouting, soaking, and fermentation on enhancing nutrient bioavailability and eliminating antinutritional factors. Findings suggest that prehistoric societies possessed an empirical understanding of the medicinal benefits of their staple plant diet, reflecting an early awareness of "food as medicine." This interdisciplinary study integrates botany, food science, and pharmacology to reconstruct ancient dietary practices and their health implications.

Keywords: Archaeobotany; Nutraceuticals; Prehistoric diets; Food processing; South India

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INTRODUCTION

As human societies evolve, their food habits undergo changes, and specialization is influenced by factors such as landscape, climate, flora and fauna availability, subsistence patterns, and lifestyle. In the early stages of being hunter-gatherers, communities developed specific skills in identifying edible and non-edible plants through generations of experience. Their diets were shaped by the naturally available forest products in their geographical location. With the advent of agriculture during the Neolithic era, communities gained the ability to cultivate specific crops of their choice, allowing them to produce food according to their needs rather than relying solely on naturally available resources in their environment. The Southern Neolithic sites and multi-period sites (Iron Age and Early History) in the core semi-arid regions (northern, eastern Karnataka, western Telangana, and Andhra Pradesh) are mostly settled in the granitic and granodiorite hills (Arjun, 2017, 2021). The hill-centered settlements with traces of multiple bedrock mortars on the bedrocks and portable stone grinders indicate seasonal engagement in the grinding and processing of food crops (see Arjun 2021, 2022, 2024)., example in the sites of Bilamrayanagudda Gudda, Sanganakallu-Kupgal, Watgal, Tekkalakota, etc. Often, the bedrock mortars and grinding slicks are associated with rock bruisings, water pools, and spring locations, suggesting key socio-economic activities were centered in well-defined locations (Arjun, 2018, 2018a, 2018b, 2022a). Neolithic crop suits, sampled as charred grains, illustrate wide varieties of crop cultivations in cereals, pulses, and millets with a combination of both summer and monsoonal cropping seasons (Fuller et al., 2018). Further rock shelter locations must have emphasized keeping a watch on cultivable landscapes and storing food grains (Arjun and Pal, 2023-2024).

Southern Neolithic Culture (3200-1200 BC)

From 3200 to 1200 BC, South India's Neolithic period is characterized by unique features such as ash mounds—accumulations of burned cow dung indicative of a pastoral economy. Recent research identifies the northern Maidan of Karnataka and South West Andhra Pradesh as the hotspot of the development of independent domestication of indigenous crops around 2500 BC, with archaeological evidence of agriculture emerging by 2200 BC (Korisettar, 2002). The early neolithic stages show the parenchyma evidence of tuber, rhizome, and forest product consumption. Key crops included horse gram, green gram, brown top millet, and bristly foxtail millet. There hasn't been any evidence in the Indus Valley or Ganga Valley neolithic, but the diffused evidence assumed from South India has been observed in the late Ganga Valley neolithic (Fuller, 2018). Foreign crops like sorghum, finger millet, pearl millet, cowpea, and hyacinth bean were introduced by the late Neolithic period (1600-1500 BC), alongside other millets and pulses such as kidney bean, chickpea, and Indian pea, which were staples in the Neolithic diet (Boivin et al., 2018).

Iron Age Culture (1200-300 BC)

Between 1400 and 1200 BC, South India experienced a transition from the Neolithic to the Iron Age, characterized by extensive megalithic burial practices. Known as the Megalithic Age, it spanned from 1200 BC to 300 BC, predating similar developments in the Ganga Valley. During this time, settlements shifted from hilltops to plains with better agricultural potential and irrigation. New crops like rice (Civan and Brown, 2017)and kodo millet were introduced, alongside winter crops such as wheat and barley, after 1900 BC (Fuller, 2018). Despite these introductions, millets and pulses remained the primary staples. Iron Age societies in South India saw a shift towards settled farming, alongside some continued semi-nomadic pastoralism, with an increase in specialized crafts and labour. Across the different ecological conditions, despite the semi-arid Deccan Plateau and tropical wet regions of Western Ghats, paddy and ragi (finger millets) came to be cultivated mainly as indicated through the megalithic repositors (Arjun 2016, Arjun et al., 2019).

Early Historic Period (300 BC- 500CE)
In south India, the early historical period begins around 300 BC and continues up to 500 CE. The Sangam literature recorded the period and later included it. So, the society is a village-based economy based on 5 Tinas as explained in Sangam literature. Each has a different economy: hunting, gathering, fishing, agriculture, pastoralism, and robbing based on the natural resources in each landscape. The society prevailed on a barter system and having more specialized labour. The food diet has changed according to each time, but the millet pulses economy dominated, and rice also became a staple food in later periods. The Sangam literature has some background references to traditional medicines, Siddhas, and medicinal practices. So, early history can be interpreted as a period with well-developed medicinal knowledge and practices. Rice became a significant crop reported at the transitional levels to the early historical and continued in the early historical period. Still, the millet pulses economy was the primary staple diet along with cereal grains.

ARCHAEOBOTANICAL STUDIES IN INDIA

Archaeobotany integrates botany and archaeology to study plant remains at archaeological sites, providing insights into ancient cultures and economies (Fuller, 2000). This interdisciplinary field analyses biocultural aspects and agricultural practices, revealing plant dispersals, trade networks, and regional economies in the past. Key evidence includes seeds, charred parenchyma fragments, wood, pollen, phytoliths, and plant impressions.

Seeds are commonly found evidence in archaeobotanical studies and preserved through waterlogging, mineral formation, or charred remains (Fuller, 2018). Pottery impressions also provide evidence of seeds, often in carbonized or silicified forms. Recent advancements allow for genetic analysis of seed remains, and the floatation technique has increased sample recovery (Fuller, 2018).

The archaeobotanical research in India has been concentrated on analysing the origin and development of agriculture, intensification by irrigation facilities, agricultural patterns (Fuller, 2018), and its socio-cultural contribution, i.e. development of kingdoms, and centralized politics of the early historic period. It has illuminated indigenous domestication hotspots, particularly in South India, revealing crop adoption patterns and diffusion across regional and cultural zones. Evidence from archaeobotanical data has even suggested ancient maritime trade relations with Africa. Dorian Q Fuller's pioneering contributions since 1996 have reshaped our understanding of India's agricultural history, reconsidering bioarchaeological evidence. Studies by Hather John in 1991 emphasized the role of roots and tubers in early diets and the origins of agriculture in Southwest Asia and Europe. MD Kajale's extensive work includes analyses of ancient grains and agricultural patterns during the Chalcolithic period and the 1st millennium BC, based on Paleo-botanical remains from excavations at Veerapuram. Ravi Korisettar's research has focused on monsoon dynamics and the evolution of prehistoric cultures. Other notable scholars like DD Kosambi, Meher-Homji VM, MLK Murthy, and Subhash Chandran MD have also contributed significantly to India's ecological and agricultural history through their archaeobotanical and Paleo-botanical investigations.

Archaeobotanical research in India post-2000 has been instrumental in reconstructing past agricultural systems, foodways, and cultural interactions by analyzing plant remains, enriching our understanding of India's agrarian past. Studies have revealed the domestication and cultivation of indigenous crops such as rice (Oryza sativa), millets (Pennisetum glaucum, Setaria italica, etc.), pulses (Vigna radiata, Cicer arietinum, etc.), and other plants essential to ancient diets and economies. For instance, Fuller and Qin (2009) highlighted the early cultivation of millets and rice in South Asia, shedding light on their roles in subsistence strategies.

Moreover, archaeobotanical investigations have documented the spread and adoption of foreign crops like wheat (Triticum aestivum) and barley (Hordeum vulgare) from West Asia during different periods (Fuller, 2010). These introductions influenced agricultural practices and diet diversification across regions of the Indian subcontinent. Advancements in paleoethnobotanical techniques have enabled the identification of ancient plant residues, providing insights into food processing methods, culinary practices, and trade networks during prehistoric and historical periods (e.g., Weber et al., 2010)

AIMS AND METHODS

In the prehistoric period, as societies sought to determine which food crops to cultivate, various factors were likely considered, including ease of cultivation, adaptability to climate, soil and water resources, and overall crop yield for the population. This research suggests that prehistoric societies have also taken into account the capability of food crops to provide essential energy and promote health. This implies a potential awareness of these crops' nutritional values and health effects, hinting at an early understanding of using 'food as medicine.' The hypothesis gains support from the prominence of this concept in Ayurvedic medicinal practices, notably during the Vedic period, indicating that prehistoric communities might have been in a proto-state of such developments.

This research adopts an innovative approach by examining the diet of prehistoric South Indian communities as a potential indicator of their medicinal knowledge. Utilizing archaeobotanical data from excavated sites in South India, the study identifies staple food crops to explore their nutritional content and nutraceutical values. The research also delves into the impact of food processing on altering nutritional content, nutraceutical effects, therapeutic properties, and eliminating anti-nutritional factors. Emphasis is placed on understanding specific processing methods as potential indicators of knowledge about these effects, indirectly reflecting an awareness of nutritional content. Additionally, a minimal exploration of ethnographic traditions provides insights into practices related to these food crops, further connecting to the overall awareness. The interdisciplinary study combines botany, food science, pharmacology, and ethnography to analyze archaeological evidence supporting the presence of medicinal knowledge in the staple plant diet of prehistoric South Indian societies. The research primarily relies on published reports on archaeobotanical samples from the Neolithic, Iron Age, and Early historic periods at excavated sites in South India, as well as analytical reports on the nutritional content and nutraceutical values of modern species corresponding to these ancient crops.

STAPLE PLANT DIETS ARCHAEOBOTANICAL DATA OF EARLY AGRICULTURE IN SOUTH INDIA

Archaeological evidence suggests pulses, millets, and related grass varieties were staples in the ancient Deccan region (Kosambi, 1963). However, analysis of excavated sites indicates an early reliance on tubers and rhizomes, likely gathered from forests or cultivated domestically. Tuber species such as wild yams, ginger, and turmeric were common in the diet, along with other forest products like fruits, nuts, and honey (Korisettar et al., 2002).

In later periods, the dietary focus in the Deccan region shifted towards a millet and pulses-based economy, with Neolithic farmers predominantly consuming millet-pulses cuisine. The most prevalent pulses during this period were Horse gram (Macrotyloma uniflorum) and Green gram (Vigna radiata or Phaseolus radiata), along with Black gram. (Korisettar et al., 2002) (Kajale, 1984). During the later stages of the Southern Neolithic period, new pulse varieties like Pigeon pea(Cajanus cajan L)(Venkata Subbarai and Kajale, 1991) and Hyacinth bean (Lablab Purpureus) were introduced (IAR 1980-81), potentially originating from Africa (Korisettar 2002). Additional pulse varieties like Kidney bean (Phaseolus vulgaris), Indian pea (Lathyrus sativa), Common pea (Pisum arvense), and Chickpea (Cicer arietinum) were also in use (IAR, 1974-75).

Millets might have naturally been present in the grasslands, and later, the focus shifted to its cultivation and inclusion in diet (Korisettar et al., 2002). The origin is traced to South Asia rather than Africa, as claimed in the past.(Korisettar et al., 2002). The most dominant archaeobotanical samples obtained are of foxtail millet (Setaria sp); Kadabekale including bristly foxtail millet (Setaria verticillata); Sanganakallu (Fuller) and yellow foxtail millet(Setaria pumila or Setaria glauca) (Korisettar et al., 2002). Brown top millet (Macrotyloma uniflorum) identified at Sanganakallu (fuller) in large quantities suggests it was a staple food crop of the region. Kodo millet (Paspalum scrobiculatum) is another millet variety reported from Veerapuram, Andhra Pradesh, in the megalithic layer dating to the 2nd millennium BC (IAR 1980-81, Kajale, 1984). It was majorly in use and cultivation during Iron Age of South India. Little millet /samai (Panicum sumatrense) originated probably in the peninsular region of Northern Andhra / South Orissa / South Madhya Pradesh also present in several sites. Sawa millet (Echinochola colona L), a native crop of the peninsula, was also reported from several sites (Korisettar et al., 2002).). There varieties such as Finger millet/ragi (Eleusine Coracana L), Great millet/ Indian millet/ Sorghum (sorghum bicolour L Moench), Pearl millet (Pennisetum glancum L) are of African origin and later gained importance in south India.(Korisettar et al., 2002). Iron Age witnessed advances in irrigational technology and the introduction of new cereals like Rice (Oryza sativa) (IAR 1987-88), Wheat(Triticum sp), and Barley (Hordeum vulgare).

NUTRITIONAL POTENTIAL AND NUTRACEUTICAL BENEFITS

During the Neolithic period, a mix of hunter-gatherer, semi-nomadic pastoralist, fishing, and farming communities necessitated a diet rich in protein, fat, and dietary fibre. Millets provided fibre and ash content, while pulses offered protein and fat, making a millet-pulse diet ideal for meeting nutritional needs. In the later Iron Age, settled life expanded, introducing cereals high in carbohydrates like glucose to support labour-intensive activities. The pharmacological studies and phytochemical studies of the modern Paleo-crop species have identified numerous nutraceutical and therapeutical values it possesses.

Pulses

Pulses, a staple in prehistoric diets, provide a rich source of protein, essential for balanced nutrition even without meat, milk, or egg supplements. They contain bioactive peptides with disease-fighting properties such as antioxidant, antimicrobial, and anticarcinogenic effects aiding in preventing conditions like Alzheimer's and Parkinson's. Additionally, pulses' high fibre content helps modulate blood glucose, cholesterol, and gastrointestinal health, while their anti-nutrients, like tannins and phenolic acids, contribute to reducing intestinal diseases and coronary heart diseases (Cardador-Martinez et al., 2002). Phytic acids in horse gram are identified to reduce the common cold, asthma, bronchitis, leukoderma, and urinary stones (McDougall and Stewart, 2005). Pulses like green gram are particularly beneficial for pregnant women due to their folic acid content, promoting haemoglobin count, neurological development, and lactation. The carbohydrate myoinositol in hyacinth beans helps to maintain proper ovarian function. Steroids and alkaloids in the bean have therapeutic use in cancer treatment, and flavonoids reduce breast cancer progression (Naeem et al. 2020; Snafi and AE, 2017).

Pigeon peas contain a significant amount of vitamin B and carotenes (Miller et al., 1956). Pigeon pea leaves, seeds, and roots also have therapeutic properties. Pigeon pea is used by many Chhattisgarh sickle cell disease patients to reduce erythrocyte sickling (Verma, 2015). Anaemia was traditionally treated with the use of the pigeon pea plant (Kone et al., 2011). According to Grover et al. (2002), the seeds are also used to treat diabetes, diarrhoea, hepatitis, and malarial treatments. Kidney beans can be one of the best diets for celiac disease patients since it is gluten-free with vitamins and mineral richness (Niewinski et al., 2008). Red kidney beans contain phenolic acids that have anticancer properties (Nyau, 2014; Duranti, 2006). Chickpeas dramatically reduce insulin resistance and guard against post-prandial hyperglycemia and hyperinsulinemia (Yang et al., 2007).

Overall, the consumption of pulses in prehistoric and historic communities has been associated with significant health benefits, including the prevention of cancer, gastrointestinal diseases, cardiovascular diseases, and regulation of blood glucose and cholesterol levels.

Millets

Millets, particularly finger millet, are recognized as nutraceutical crops due to their high dietary fibre and phenolic acid content, making them beneficial for diabetic patients and offering protection against infections like leukaemia (Chandra et al., 2016). Additionally, millet's dietary fibre helps resist ageing, metabolic diseases, and LDL cholesterol (Scalbert, 2005) while improving gastrointestinal health (Chandra et al., 2016). Regular consumption of whole grain finger millets and their products can provide protection against the risk of cardiovascular illnesses, type II diabetes, gastrointestinal malignancies, and other health difficulties (Mckeown, 2002). It is an excellent natural iron supply for plants. Foxtail millets have been associated with reducing chicken pox, heart attacks, fevers, cholera, and gastric problems (Satyarthi et al., 2018), while kodo millet is rich in B vitamins and minerals (Chandra et al., 2016), with therapeutic effects on depression, anxiety, insomnia, migraine, and colon cancer (Satyarthi et al., 2018).

Pearl millet intake can prevent pellagra, a niacin deficiency disease, and sorghum millet is suitable for celiac disease patients, offering protection against metabolic disorders like diabetes and hyperlipidemia, as well as possessing anti-mutagenic and anticarcinogenic properties (Rai et al., 2008; Gopalan et al., 2003). Sorghum's high dietary fibre content helps to satisfy the appetite, boosts satiety, and lowers the chance of developing obesity. Overall, millet provides numerous nutraceutical benefits, promoting a healthy lifestyle and protection against various diseases.

Cereals

Cereals such as rice, barley, and wheat held minor importance in the prehistoric diet of South India despite their reported presence. Barley exhibits anti-diabetic, anti-cancerous, and anti-obesity effects, preventing cell proliferation and chronic diseases like colon cancer. Rice is rich in B vitamins, aiding in treating deficiencies and possessing anti-inflammatory, anti-cancerous, and cholesterol-lowering properties, although its high glycaemic index value may pose risks for diabetes (McKeown et al., 2002) Wheat consumption is associated with health benefits, including reduced coronary heart diseases, cancerous growths, neurodegeneration, improved immune and vascular functions, and antioxidant properties.

EFFECTS OF FOOD PROCESSING TECHNIQUES IN NUTRITIONAL COMPOSITION

The presence of archaeobotanical samples alone may not perfectly validate that the prehistoric society was aware of the nutritional potential and nutraceutical values attributed to certain crops in ancient diets. Research into food processing techniques and their impact serves as one validating factor, addressing why certain crops were soaked, roasted, germinated, fermented, etc. Understanding these practices sheds light on the awareness of these crops' nutritional potential and effects in ancient societies.

Sprouting horse gram seeds increases the bioavailability, palatability, and digestibility of nutrients while soaking, drying, and roasting eliminates anti-nutritional factors. Similarly, germination enhances amino acid content and protein digestibility

In green gram sprouting increases the ascorbic acid (Vitamin C) content (Adsule et al 1986). In the case of black gram, dehulling will reduce the Ca, Mg, Fe content so more mineral absorption is possible by intake of seeds without dehulling and these minerals are essential for bone formation, bodily hormone secretion, neurological system function, and blood pressure control. Zn, Cu, Mn, and Fe have the ability to heal wounds, produce energy, and promote growth, and germination will increase the levels of the first three minerals. (Kamani and Meera 2020). In hyacinth bean, the negative effects of the antinutritional factors can be eliminated through cooking. Chemical soaking, germination, and boiling of pigeon peas will reduce the polyphenolic compounds, which cause problems by inhibiting digestive enzymes.

The experiments of foxtail millet have analyzed that the soaking time, germination time, and provided temperature have effects on its flavonoid phenolic acid content and antioxidant activity. It increases protein, dietary fibre, Ca, Mg, Fe, and Na amounts. The alkaline cooking, fermentation, and popping methods also improve protein quality (Sharma and Niranjan, 2018). In finger millets, germination improves the Fe levels, and fermentation increases the production of metabolites, thus reducing cholesterol and improving carbohydrate digestibility (Chethan, 2008; Manzoni et al.,1999; Venkateswaran and Vijayalakshmi, 2010).

The fermented drink is a therapeutic agent against diarrhoea (Lei et al.,2006). Puffing and popping increase the protein content in Kodo millet (Jayabhaye, 2014) and germination increases minerals and anti-oxidant activity also (Sharma et al., 2016). When brown top millet is soaked and fermented, the interaction between nutrients and anti-nutritional factors is reduced, resulting in an increase in the amount of phenolic compounds and antioxidant activity (Singh et al., 2021). Dehulling in the pearl millet increases the niacin content and prevents the deficiency disease pellagra. Phytic acid and insoluble fibre content is reduced by germination, and soluble fibre is increased. Fermentation also decreases the phytic acid levels and enhances mineral extractability. Soaking and germinating the sorghum seeds will cause the synthesis of vitamin C in them (Pushparaj and Urooj, 2011). GI value in sorghum can be reduced by boiling and fermentation. Additionally, fermentation also reduces serum glucose, LDL, cholesterol, and triglyceride levels.

In the case of cereal rice, the pregerminated brown rice has 2 times more protein and higher fat than white rice. Parboiling of the milled rice increases the ash content, potassium, and phosphorous and decreases Mn, Ca, and Zn levels. Germinated ones have high nutritional content, better digestibility and absorption. Fermentation reduces the phytic acid content. For barley, boiling helps to regulate glucose levels, and fermentation enhances the anti-obesity factors.

CONCLUSION

The research paper investigated the dietary habits of prehistoric communities in South India and their potential medicinal knowledge by analyzing archaeobotanical data. It explores the transition from hunter-gatherer diets to agriculturally based diets, emphasizing the nutritional content and nutraceutical benefits of staple crops such as pulses, millets, and cereals. Findings reveal a shift in dietary focus towards millet-pulse cuisine during the Neolithic period, with pulses and millets providing essential nutrients like protein, fibre, and fat. The paper highlights the medicinal properties of these crops, including their antioxidant, antimicrobial, and anticarcinogenic effects, as well as their role in preventing various diseases such as Alzheimer's, Parkinson's, and cardiovascular diseases. Moreover, it discusses the impact of food processing techniques on nutritional composition, showing how methods like sprouting, soaking, and fermentation enhance nutrient bioavailability and eliminate antinutritional factors. Overall, the study suggests that prehistoric South Indian societies possessed an empirical knowledge of the medicinal benefits of their staple plant diet.

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