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Traditional Foods and Farming Models are Valuable for Tribal Farmers Health and Nutrition Security

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ABSTRACT

The food ingredient composition of tribals have been changed from organically grown nutrient affluent millets, pulses, underutilized fruits and vegetables to chemically grown less nutritious rice, wheat, hybrid maize, potatoes, modern fruits and vegetables with residual loads of agro-chemicals. The physical working efficiency and health significance of tribal youths were continually deteriorating and they have lost interest in adopting agriculture as occupation and resulted in a significant increase in migration from original habitation to nearby towns or cities. The social reputation of farming and animal production occupation was also reduced among tribal youths due to harsh work environment, well-being of farmers and socio-economic revaluation in tribal areas. For exploring the changes in dietary composition, working efficiency, and interest in agricultural activities of the tribals, a comprehensive analysis of 85 studies available from literature and for factual validity of the results also conducted a wide-ranging field survey of tribal dominated areas. The maximum tribal farmers were found to be physically weakened, had lower immune systems, severely malnourished along with multiple nutrient deficiency disorders due to poor dietary intake because of ignorance of their traditional diets. This critical review emphasises the importance of balanced and adequate nutrition, popularization of traditional food products, adopting organic and traditional farming models for farmers good health and well being. Raising their physical work efficiency and also mental state for adopting agricultural occupation, reduce migration, improve socio-economic status and social reputation among tribal farmers.

Keywords: *Health, Malnourished, Millets, Nutritional Security, Physically Weak, Underutilized Fruits, Well Being.*

Background

In previous the tribals of Rajasthan was well acclimatised in natural settings and have very good capability to do vigorous physical and energy intensive work such as manual farming, pulling water, grazing of domestic animals, gathering and harvesting of crops from uneven fields, hunting of wild animals in adverse environmental conditions for long duration without any perfunctory supports. They were also proficient to walk for long distances in rocky and undulated areas with additional overhead weight. The tribal farmers gained all required daily calories and nutrition from consuming their daily diets of traditional food crops, fruits and vegetables to protect their health, increase work performance and maintain efficiency (Anonymous 2020; Bhardwaj et al. 2024). Since ancient times, millets and traditional fruits and vegetables have been widely grown and are the main staple food for the tribal farmers, but the area under these crops has been declined steadily over the past seven to nine decades and rapidly after the green revolution period due to their lower economic competitiveness with major commodities like hybrid maize, wheat, rice, potatoes and lack of knowledge about their nutritional importance. Both the historical records of cropping patterns and the dietary habits of tribals indicated that millets and traditional crops have a distinct position and a well-defined role in providing food as well as nutritional security of tribals, which are now only occasionally eaten by the newer generations (Nandal and Bhardwaj 2013; 2015) The food consumption patterns tribals have shifted from low caloric and nutrient-rich foods such as millet, naturally grown fruits and vegetables as fresh and dried to energy dense foods such as chemically produced high yielding rice, wheat, hybrid maize and potatoes with a greater consumption of saturated fats, oils, animal based foodstuffs, lower category processed foods and a higher intake of soft drink and wines (Anonymous 2020; Bhardwaj et al. 2024). Drastic modification in the daily diet consumption and advancement in technological support in agriculture from beginning of the agro-industrial revolution, the physical and mental performance of tribal farmers about agricultural activities showed in decreasing trends and significantly increase prevalence of wine consumption as well as non-communicable diseases such as cancers, cardiovascular problem, diabetes and chronic lung illnesses (Nandal and Bhardwaj 2013).

Average decrease in working capacity of the tribal farmers during last sixty years was 46.07 per cent (Bhardwaj et al. 2021) due to trim down intakes of traditional fruits, vegetables and minor millets (Longvah et al. 2017), which lead to increasing prevalence of physiological disorders and reduced working efficiency (Misra et al. 2011). Authors are reported that the traditional Indian snacks widely used by tribals like jaggery (rich in iron and energy), watermelon seeds (super rich in protein, fats, zinc, magnesium, potassium with low calorie count), green gram sprouts (excellent source of protein, vitamins, amino acids and minerals), roasted sorghum seeds (gluten free rich in fiber, protein, zinc and iron), cooked barley seeds (exceptional source of vitamins, fiber, molybdenum, manganese, selenium, copper, phosphorus, magnesium and niacin), gingelly seeds with gur (good source of healthy fats, protein, B vitamins, minerals, fibers, antioxidants and phytosterols), salted groundnuts (best sources of fat, protein, fibres, potassium, calcium, phosphorus and B vitamins), roasted Bengal gram contribute significantly to higher minerals and energy intake, all are

good for immune system, risk of certain cancers, control blood sugar level, heart health, improve digestion and weight loss to lower cholesterol level, while today there is a lofty preference for highly processed less nutritious foods, such as burgers, pizzas, French fries, chips, coloured candy's, biscuits, fat containing bakery items like cake, noodles, puffs which are made of wheat/rice crush with baking powder, by using preservatives and artificial food colours.

There were many factors responsible for the food habit transition such as change in crop production technologies, poor taste quality of traditional foods, typical food preparation methods, easy availability of modern foods products and drinks. The greatest factor contributing to changes of food habits of the tribals are the well known government public distribution system of the food products such as wheat, rice, oil, sugar, dairy products, and processed products with additional amounts of preservative chemicals, rather than organically grown nutrient rich traditional foods. Since time immemorial hidden hunger in terms of less intake of quantity and quality of nutritive food and other socio-economic factors are responsible for drastically reducing physical working capacity, health status and in turn people becoming lazier and weaker (Bhardwaj et al. 2021; Bhardwaj et al. 2024). The threat of being overweight rose to 11.8 per cent in men and 15.5 per cent in women (NNMB, 2012) (Longvah et al. 2017). Occurrence of child undernourishment at 45.9 per cent (National Family Health Survey NFHS-3, 2006), any anemia at 79 per cent among 6-35 month children (NFHS-3, 2007), underweight among women at 35.6 per cent (NFHS-3, 2007), anemia persistency among women of 15 to 49 years at 55.3 per cent (NFHS-3, 2006), diabetes at 8.63 per cent (International Diabetes Federation IDF, 2014), hypertension at 22.2 per cent in men and 21.6 per cent in women (NNMB, 2012) came to be matters of new public health concern due to imbalance dietary intake and faulty daily life activities (Longvah et al. 2017).

Traditionally the tribals consume diverse diets, mainly consisting of millets, underutilized fruits and vegetables, hence higher intake of micronutrients, reduced incidence of nutrition related chronic diseases and uphold physical working efficiency (Nandal and Bhardwaj 2013; Pingali 2007). A shift in food habits among Mauritians, increased use of cheap processed food high in starch, fat and sugar, which causes deficiency disorders, increase cardiovascular diseases, cancers and diabetes (Fiolet 2019; Siegal 2016) and significantly reduces physical working capacity (Popkin 2002). Because of insufficient nutrition, the immune system of the hospital employees weakens and the incidence of illness increases, resulting in reduced working productivity (Akhlaghi and Behrouz 2015). Also, significant reduction in mental concentration due to hypoglycemia in malnourished and underweight farmers increases occupational hazards such as accidents during field work with machines (Bhardwaj et al. 2021). Nandal and Bhardwaj (2013) reported that those tribal farmers consuming nutritious traditional fruit and vegetables in daily diets were stronger and efficiently performed all agricultural work. In this concern it is necessary to consume balanced and adequate nutrition from traditional food products grown organically to maintain optimum physical working capacity and healthier life of the tribal farmers. Hypothesis behind the review on burning but hidden issues of reducing physical working efficiency with previous studies and experiential survey in tribal areas of Rajasthan to evaluate the traditional

foods and farming models for farmers good health, well being and socio-economic sustainability.

Method

Reporting of this review was done following the Preferred Reporting Items for Systematic Reviews (Page et al. 2020). For exploring the changes in dietary composition and agricultural working efficiency of the tribals a comprehensive analysis of 85 studies available from literature and also done a wide-ranging field survey of tribal dominated areas of southern-western Rajasthan during the year 2016-17 to 2020-21 throughout the RKVY project among tribal farmers. Different databases were selected for literature research such as Springer, Taylor and Francis, Ebsco, PubMed, Scopus, Web of Science and other online published research papers, review, reports, books, survey results and proceedings. The search and selection process was performed by authors working independently and in an analogous team. Searches comprised a combination of different related terms and keywords such as malnourished, millets, nutritional security, physically weakened, underutilized fruits, traditional food produce, working efficiency, interest level of youths migration from tribal areas. The initial search resulted in 247, from which 145 was removed because of the not concern for tribals and traditional diet composition. After removal to non related publications, 17 reviews and research paper deletion due to duplicate and similar results. After the removal of duplicates other unrelated literature finally 85 studies were identified for screening with 52 eligible full text research papers and 6 review studies were selected and included in this review. The process of literature search and selection criteria according to Page et al. (2020) model is presented in Figure 1. The authors have been working in tribal areas since 2008, so their actual fact and long experience with tribal society, particular working efficacy, food composition, youth interest and social reputation of the agriculture occupation changes are also incorporated in review writing. For supporting the results of primary data, the secondary information was collected from published and unpublished sources. By using descriptive statistics the data was analyzed by calculating simple mean and percentages and arranged in figures in a very simple manner for clarity.

Result and Discussion

Traditional foods and nutrition transition

Economic liberalization and globalization changed the food and nutrition scenario in India as well as the tribal area of Rajasthan. In between 1990 to 2010 increased consumption of fruits 94 per cent, starchy roots 52 per cent, vegetables 40 per cent and resulted that the significant raised in the daily per capita supply of energy upto 11 per cent, protein 12 per cent and fat 30 per cent (Longvah et al. 2017), whereas significant reduction in micro nutrient supply from diet due to nutrient dilution effects. Before the advent of green revolution and economic transform in tribal dominated areas of Rajasthan, traditional foods were composed by organically cultivated millets such as pearl millet and sorghum, minor millets *viz*., finger

millet, proso millet, foxtail millet, kodo millet, little millet and barnyard millet; traditional fruits such as wild date palm, custard apple (*sitaphal*), ber, *rayan*, *jamun, pilu, ker, lasoda*, tamarind; organically cultivated vegetables like cluster bean, snapmelon, *kachri* and naturally grown leafy vegetables *bhatuwa*, *choulai*; root staples such as sweet potato; grains like beans and barley; fresh milk obtained through rearing of animals based on grazing at naturally diversified grasses like goat and cows (Bhardwaj et al. 2024). All these traditional foods were originated from local plant or animal resources through gathering and harvesting, and these foods also bear cultural meaning (Earle 2011). With passage of time some foods became popular and gradually remain were disliked on the basis of the taste, texture, availability and appearance of foods and they has been a shift towards consumption of energy-dense, processed, chemically grown foods and significant changes were observed in lifestyle such as less time devoted for meal preparation (Bhurosy and Jeewon 2016).

Many of these traditional crops were believed to contribute to efficient nutritional security through reducing dependency on one or two staples, contributing to food quality and maintaining dietary diversity (Mayes et al. 2011). In 1960 the average daily diet consisted by a significant contribution of minor millets (13%), sorghum (13.2%), pearl millet (19.3%), *desi* maize (36.5%), barley (4.5%), wheat (1%), pulses (5.5%), meat (3%), dairy product (1.5%), sugar and oil (0.5%), traditional fruits and vegetables (5.5%) and there was no consumption of rice and modern fruits, wheat consumed rarely on specific festivals and in presence of very important guests (Anonymous 2021), whereas, today daily diet of the tribals are mainly consisted by minor millets (0.2%), sorghum (1.0%), pearl millet (5.3%), hybrid maize (10.2%), barley (4%), wheat (56%), rice (7.5%), pulses (2%), meat (4.2%), dairy products (3%), sugar and oil (2%), traditional fruits and vegetables (3%) and modern fruits and vegetables (3.5%) (Bhardwaj et al. 2021). The most undesirable feature of this transition in daily diets is the substitution of nutrient rich millets with socially more prestigious and less nutritious refined grains. Similarly, during the 1970s, instead of meat and meat products, whole grain cereals, pulses, fruits and vegetables were more often consumed by the Indians (Subramaniam et al. 2014). The food consumption patterns transformed because of changes in agricultural intensification, poverty, population pressures, urbanization, lifestyle changes (Fanzo et al. 2012), demographics, economics, socio-political context, cultural perspective, science and technological development (Ericksen 2007), media interference, food prices, climate change (Schmidhuber and Tubiello 2007) and an increase in the Gross Domestic Product (Gerbens-Leenes et al. 2010). Alterations in food supply and the abundance of cheaply available fast food and supermarkets may be the main causes of this shift from vegetable to animal protein (Aurino et al. 2017).

During the green revolution mainly emphasized on high-yielding varieties of wheat and paddy and increasing availability and affordability of low-nutrient dense foods, which decreased consumption of nutrient affluent and well acquainted coarse cereals, pulses, underutilized fruits and eventually resulted in loss of fibre and micronutrients from daily diets (Pingali and Khwaja 2004; Pingali 2012). Indians shifted from consuming invisible fat of plant food to visible fat from animal products and fat intake increased by 7 per cent from 1980

to 2004 (Anonymous 2004). The consumption of coarse grains per capita decreased in both urban and rural areas by 24.46 kg and 9.73 kg, respectively, from 1987 to 2010 (Arora et al. 2014). The expansion of fast-food industry, western culture in food consumption pattern resulted in a shift in dietary patterns from a healthy traditional diet such as high-fibre vegetables, fruit, legumes and coarse grains to an unhealthy diet which is high in calories, saturated fat, salt, sugar, animal protein and carbohydrate (Bowman 2005), whereby Indian origin traditional fruits were rich in protein, iron, mineral and vitamin content being less consumed (Nazarudeen 2010; Popkin 2014; Soon and Tee 2014). Increases in rice consumption have corresponded with decreases in the consumption of *roti*, a flatbread which is typically made from local grains, including wheat, barley, millet, buckwheat, and maize, in addition to declines in other recipes which require local crops (Bhurosy and Jeewon 2016). Decline in pulse production from 28.4 kg/capita in 1960 to 14.2 kg/capita in 2000 (Ramasamy and Selvaraj 2002), similarly the consumption of pulses fell by almost half between the 1950s and 2015 (Joshi 2016). The traditional wine (*desi daru*) typically prepared by high nutrients and phyto-chemical containing wild plants products such as *mahua* flowers, local spices, barley seed and plant barks, consumption trends also decreased significantly from 100 per cent (1960) to 34.2 per cent (2020), whereas modern wine (English wine) which containing higher alcoholic compounds have detritions effect on health, consumption significantly increased from 0.0 per cent (1960) to 65.8 per cent among tribal youths of Rajasthan (Anonymous 2021). A number of explanations were given for this decline, including preference in the taste of rice and wheat over local grains and decreased drudgery in preparing and cooking rice as compared to flatbread (*roti*) of millets.

Moreover, interventions are required in order to improve traditional food availability, change public distribution policy and also increase the awareness of consumers about unhealthy diet patterns (Shamsi et al. 2018). Indian traditional foods are also recognized as functional foods because of the presence of body-healing chemicals, antioxidants, dietary fibers, and probiotics, which help in weight management, blood sugar level balance, improve immunity of the body and physical working efficiency and fitness. Traditional food preparation patterns further enhanced nutritional quality by using processing techniques such as sprouting, blending, malting, fire cooking and fermentation (Hotz and Gibson 2007). It is the right time to rediscover and re-implement traditional practices to improve the socio-ecological integrity of agro-ecosystems and good health, well being and working ability of the farmers. Integration of traditional and modern agriculture is the necessity of the current scenario, bridge the huge gap between indigenous and modern agricultural practices.

Farming models and farm layout

Tribal dominated area of Rajasthan is full of dangerous wild animals and agricultural fields are scattered in deep forests and rocky areas which are unsafe for agricultural labourers and farmers specially farm women. In ancient times the tribal farmers had done agricultural work collaboratively by men and women in reciprocal manner (Anonymous 2021). In this way working efficiency increased due to happiness, a safe environment and excitement for doing

more work collectively and fairly. The patterns of working have changed in terms of time and presently, the maximum farmers do all agricultural work individually with the help of small equipment and mechanical supports in an unsafe manner due to scattered fields. Tribal farmers were also regularly exposed to toxic chemicals, whether from applying pesticides or from handling produce that has been freshly sprayed, or, in some instances, in direct contact of a pesticide application. In addition to these hazards, many female farm workers were subject to sexual harassment, kidnapping and abuse from supervisors or other workers (Anonymous 2012a). Last six decades have witnessed a fundamental transformation in methods of agricultural activities from human labour intensive to mechanical farming. Physical inactivity also rose in farmers due to mechanization in agriculture, which may negatively affect the health of the farmers (Mayes et al. 2011).

Excessive use of fertilizers may pollute the underground water with nitrate and it is so much hazardous to humans or livestock health, which directly affects physical working capacity and work staying power. Pesticide exposure occurring via dermal, digestive, or respiratory routes results in reduced lung function (Mekonnen and Agonafir 2004), wheezing (Hoppin et al. 2002), higher incidences of lung cancer (Beane-Freeman et al. 2005), chronic bronchitis and chronic obstructive pulmonary disease (Alif et al. 2017), coughing, rhinitis, asthma and other respiratory symptoms (Buralli et al. 2018) all these factors are declining deckling work efficiency and health status of the tribal farmers (Charavaryamath and Singh 2006). In addition, a large number of volatile organic and inorganic compounds such as agro chemicals present in the environment were known to produce unpleasant odour contributing to negative health effects (Hoppin 2006), may affect the human endocrine and immune systems and may promote the development of cancer (Hribar 2010). Improper handling of pesticides in agriculture has caused serious human health problems and adverse effect on working capacity of the farmers in many developing countries (Dasgupta et al. 2007). Organophosphate pesticides used in the vegetables gradually get deposited into the human body and have a link with cancer (Miah et al. 2014).

Chronic exposure to hydrogen sulphide can cause brain and heart problems and be deadly even at low levels (Anonymous 2014a). Pesticide residues in food and bovine milk cause many kinds of cancer, acute and persistent injury to the nervous system, lung damage, injury to the reproductive organs, neuronal disorder, degenerative diseases, some affect terminal growth and cause congenital anomalies dysfunction of the immune and endocrine systems and birth defects (Nicolopoulou-Stamati 2016; Mamane et al. 2015; Rahman and Debnath 2015; Thuy 2015). Regular inhalation of particulate matter such as dust can cause both respiratory and heart problems, while high levels of ammonia can cause asphyxiation (Anonymous 2018). Excess nutrients from over application of synthetic fertilizers and animal waste becomes agricultural runoff, which can get into waterways, exacerbating algae growth in water systems, these algae produce the neurotoxin domoic acid, and eating mollusks contaminated with these strains can cause death (Bever-Fred 2018). Authors also reported that the vegetables and fruits producer tribal farmers used red and yellow labelled insecticide in many times excess doses without any safeguards for human life and environment from the

toxic effects which causes many serious health problems, even death. They are unaware about scientific handling, application and waiting periods of the poisonous agro-chemicals. So, it is compulsory to increase consciousness about the harmful effects of agrochemicals on farming in tribal areas, proper training should be given to the tribal farmers regarding organic farming, its scope, potential, and profit for environmental sustainability.

Socio-economic revaluation

In ancient times, the main prosperity symptoms of tribal society was strength of animal resource such as number of cows and bulls, land holding, water resources, human resources, stock of food grain and fodder, gold and other ornaments, whereas in present times a revolutionary change reported like residence area, house size, bank balance, business network government jobs, availability of vehicles, small family size, education level and adoption of western culture are symbol of affluence. The social alteration in India is more complex and extra societal changes occurred during the last few decades like people were migrating from rural to urban areas, per capita income is growing, literacy is increasing, number of working women are becoming more and household size is decreasing. During socio-economic revolution the tribals habits was also shifted from traditional diet to processed, unhealthier, and oilier caloric foods (Swaroop and Repalle-Giddaiah 2020) with drastic change in food intake and preparation method such as before sixty years 100 per cent tribals were prepare by fire cooking methods where as at present maximum are used LPG for food preparation.

In urban as well as tribal areas people tend to attract towards processed foods, they tend to be ready to eat foods, which feel tasty, colourful and have more flavours even though there is no nutritional value. Refrigeration of stock and a larger variety of produce from across the world at more affordable prices and the increasing in floor space opened a door for manufacturers and retailers to showcase for giving consumers an opportunity to compare products and select their preferred choice (Gofton 1995). Globalization of food markets, fast food chains, and the increasing availability of street vendors, offer food at very competitive values, and influence the eating habits of low socio- economic status people (Bhurosy and Jeewon 2014). The modern era witnessed new and innovative ways of food consumption viz. quick foods, processed foods and chemically grown fruits and vegetables, as a result of humankind moving away from natural food (Damodaran 2018). There were lower levels of food eating when people eat alone and more when eating occurs in a group setting, especially when the groups are composed of familiar people. As income decreases, the consumption of vegetable oils and fast food increases, while healthy foods such as fruit, vegetables, legumes, fibre and coarse grains decreases (Sebastia 2013). Present socio-economic revaluation significantly affects the food habits, work culture and working efficiency of tribals.

Approaches to sustain health and working capacity of tribals

Traditional farming practices used principles and techniques that do not rely on mono-cropping or intensive use of chemical fertilizers and poisonous pesticides. The prehistoric

agricultural activities incorporate fair and safe working conditions which do not pose a public health threat as present farming operations do. The consumption of many traditional foods can be traced back those centuries ago to a more prestigious position and also revive the well statuted traditions of the tribals for nutritional and cultural security. Pollution free natural environment is also helpful in making youths physically strong and healthy with enhanced capacity to do additional work in unfavourable environments and physiographic conditions.

Revive traditional foods and culture of tribals

Traditional foods have been consumed locally or regionally from a long time back and they were vehicles of socio-economic culture and may also possess health qualities. Traditional food products and methods for the preparation of such foods have been passed down through generations and are now part of the myths of the monarchy. Unfortunately, throughout Rajasthan some traditional foods are on the verge of extinction due to discontinued consumption, and altered lifestyles with food habits. Therefore, there is a genuine need to study traditional foods to preserve important elements of the Rajasthan culture and, if possible, enrich and improve the daily diet of the people across the whole continent. As time passed and societies evolved, the dietary preference was embodied in the culture and nutritional choices, including traditional foods, became parts of their collective identity (Behar 1976). The traditional tribal diet was characterized by a high intake of millets, underutilized fruits and vegetables, less known pulses, mustard and sesame oil, a regular but moderate intake of nutri-drink and locally made wine, dairy products mostly in the form of curd, milk and ghee, a low intake of wild animal meat and poultry (Willet 2006).

In ancient times the food production system was associated with the livelihood of the farmers, but the modern food system relies on commercial crop production practices which produce food grown specifically for higher yield, ease of transport and fast growth (Halweil 2007). Modified farming structure has resulted in a proliferation of inexpensive, predominantly prepared nutritionally poor foods from rice, wheat and potatoes resulting in a lack of nutritional diversity in the tribals daily diet. These three crops together have become a major component of the tribals daily diet due to these food supplies largely by the state Government under a public distribution system of food products that keep their costs low or distribute free in tribal dominated areas. While reliance on staple crops has grown, modern varieties of these crops have been bred aggressively to increase overall productivity through high yield but have not been bred for nutritional value. The important macro and micro nutrient content of these crops has declined, as compared to their historical cousins, similarly the nutrient content of animal products has also declined with the rise of modern agricultural production due to eating less nutritive food by the animals than the traditional system (Evich 2017; Halweil 2007). Meenakshi (2016) reported increased food availability but iron and zinc intake per capita per day has fallen in India, it may have reduced the production of iron and zinc rich food in the form of pulses, coarse cereals, millets and traditional fruits and vegetables. Most current national databases are lacking nutrient data on the country, specifically traditional foods and this information is necessary in order to accurately estimate

daily dietary intakes (Harrison 2004). Farmers due to dogged work and low profit shifted from traditional agriculture towards the modern one, it enhanced food productivity but with the acceleration of several environmental problems such as climate change, food in-safety, biodiversity loss, soil degradation and environmental pollution (Zhang et al. 2017). Traditional wisdom about processing of food, its preservation techniques, and their therapeutic effects has been established for many generations in India (Sarkar et al. 2015). Recently, people's interest in nutrition and healthy eating, resulted in increased demand for traditional foods, with a consequent increased interest among food manufacturers also. Organic farming also protects the environment and has a greater socio-economic impact on nation (Das et al 2020) in respect to nutrition and health security. This could prove useful to the standardization of the foods potential semi-industrial production and, combined with the emerging analytical data, could motivate local producers to register their traditional products. Therefore, organic foods ensure better nutritional benefits, health safety and it can build a nutritionally resonant, healthy, physically fit tribal youth in near future for better performance in agricultural work. However, considerable work needs to be undertaken in order to document the reported beneficial health effects of traditional foods and to explain them in terms of generally accepted physiological mechanisms.

Nutritional evolution of traditional food products

Sustainable food security depends on broadening the range of cultivated crops and must include the traditional crops like millets and underutilized fruits (Ushakumari et al. 2004; Bhardwaj et al. 2021; Bhardwaj et al. 2024), but a steady reduction has been observed in the dietary intake of all food groups including cereals especially millets since 1975 (Anonymous 2012b). Millets are quite superior to rice and wheat in term of protein, minerals (Fe, Zn, Ca, Mg, P, and K), fibre and vitamin B (niacin, vitamin B-6 and folic acid) so, they can be helpful to fight against malnutrition problem. The traditional fruits and vegetables contain 27 per cent more vitamin C than presently produced fruits and vegetables (Lairon 2010), organic plants contain double the amount of phenolic compounds than modern ones (Rembialkowska 2007) and organic wine contain a higher level of resveratrol (Levite et al. 2000). Rossi et al. (2008) stated that organically grown tomatoes contain more salicylic acid and have anti-inflammatory, anti-stress effects to prevent hardening of arteries and reduce possibilities of bowel cancer. Millets are high in proteins, carbohydrates, amino acid profile along with vitamins, minerals, dietary fibre, starch composition, phytochemicals, magnesium, folate, energy content (Fig. 2) and better than or at par with other cereals (Vadivoo et al. 1998) (Fig. 3) and low glycemic index that optimize health (Thilagavathy and Muthuselvi 2010).

In earlier times, finger millet was a major food component of Rajasthan tribals and it is rich in protein, iron, phosphorus, fibre, vitamin and extraordinary source of calcium, which is higher than all cereals and iodine content is highest among all the food grains (Antony et al. 1996). It is also high in polyunsaturated fatty acid and has best quality protein along with the presence of essential amino acids (lysine, threonine, valine) (Devi et al. 2014), sulphur

containing amino acids and the ratio of leucine to isoleucine (Ravindran 1992), vitamin-A, Vitamin-B and phosphorus (Gopalan et al. 2004). Finger millet provides the highest level of antioxidants properties, phyto-chemicals, phenolic compounds and gluten-free, has excellent malting qualities, with low glycemic index, which makes it easily and slowly digestible (Sharma-Anubhuti 2018). Hence, it helps to control blood glucose levels in diabetic patients very efficiently due to low fat and glycemic index (Seetharam and Rao 2007), and prevents constipation because of its high fibre content (Lata 2015). Little millet is gluten free, excellent in phyto-chemicals and antioxidant properties, it has nearly 2.5 times more minerals, 38 times fiber, 13 times iron than rice and 6.3 times fiber and 1.8 times iron than wheat (Figure 2). It also has a lesser amount of carbohydrates than wheat and rice and has abundant quantities of thiamine (Vitamin B_1) which is not present in rice and wheat (Verma et al. 2018).

Fox tail and barnyard millet have low glycaemic index (40-50) with high nutritional value and nutraceutical properties which help better physical and mental development. Among the major millets, pearl millet (Bajra) and sorghum are also major food constituent in antique *Rajasthani* daily diet, it has highest content of iron, zinc, Mg, P, folic acid, riboflavin, phenolic compounds and antioxidants (Awika et al. 2004). Traditional fruits and vegetables contribute significantly in maintaining tribal population nutrition, especially as a very good source of ascorbic acid, carotenoids, thiamine, riboflavin, niacin, pyridoxine, folacin, minerals, fat, protein and dietary fibre. In comparison to the traditional fruits and vegetables such as *ber*, *bael*, *ker*, *phog*, *khimp*, *khejri* pod, cluster bean, bitter gourd and *kachri* are more nutritious than modern commercial fruits and vegetables such as mango, banana, tomato and potatoes (Figure 3 and Figure 4) and highly useful for maintaining good health of the tribals for doing physical work (Nandal and Bhardwaj 2015). Nutrition should aim to achieve the highest physical and psychological well-being of the worker by providing adequate and balanced nutrition (Hakan 2020). All above traditional fruits and vegetables are present in ample amounts in tribal dominated areas of Rajasthan in specified season, but only few quantities of these are used due to unawareness and negligence, so it is necessary to improve knowledge and processing technologies to increase consumption of all these for nutritional security (Figure 5). Value-addition to millet grain also offers good opportunities to rural and tribal farmers for income generation and promotes production and marketing leading to food and nutritional security, employment and revenue generation (Nandal and Bhardwaj 2015; Verma et al. 2018). It is imperative to maintain nutritional and organoleptic value of the traditional as well as modern food products for maintaining physical and mental performance of the tribal youths.

Socio-economic development in tribal areas

In contemporary society the social reputation of small and marginal farmers, farming occupation, labour work and farming activities at lowest position, whereas in prehistoric times it was at prime position (Anonymous 2021). Earlier, due to higher social reputation and livelihood security every tribal farmer was highly interested in farming with full dedication. Another major cause of more attachment with agriculture was limited options for livelihood

security and job opportunities, and there is no other occupational opportunity available for tribal youths. The society again accepts that agricultural activities are the most socially respectable occupation and develop equality. The state government also provides economical support and develops all required facilities for staying the tribals in remote areas. Authors also reported that, before 1960 farming was the foremost reputed job, whereas business was in second position and service in third position, but with spending time in the present the service is in first position and farming is the least reputed activities in society.

It was also observed that those tribal youths employed in farming activities face problems in getting good marriage proposals whereas, those who are engaged in service and business with less remuneration than farmers are easily wedded (Anonymous 2020). Those tribal women occupied in retail marketing of vegetables have better social reputation, wealth and greater participation in social decision, planning of developmental and family activities than those employed in traditional farming (Bhardwaj and Nandal 2012). To uphold the interest level in agricultural activities it is compulsory to improve social reputation and equality with economic support to the tribal youths for continuing farming in these thorny areas.

Conclussion

The study concluded that the food habits of the tribals of Rajasthan have changed over the past sixty years as a result of diverse but interrelated environmental, social and economic factors. The shift from traditional diets to the modern diet and contemporary lifestyle in tribals have brought about serious health concerns such as a rise in chronic conditions like malnutrition, nutrient-nourishment, obesity which are the main causes of mortality, morbidity and physical weakness among tribal youths. Social reputation of agricultural activities and farming was also decreased abruptly with advancement of industrialization, which is the cause of trimming down the interest level in agricultural activities of the tribal youths. Based on the findings of this study, it is essential to focus on proper nutrient management by consuming traditional food products to build strong tribal youths for future farming in tribal dominated areas of Rajasthan and it is also necessary to conserve all traditional valuable food crops as well as improve social reputation of farming and animal husbandry occupational equals other occupations for farmers good health and well being.

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