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Anwar Hussain
High Mountain Arid Agriculture
Research Institute, SKUAST-K,
Leh, Ladakh, India

Rinchan Dolkar
Krishi Vigyan Kendra, Kargil-I,
SKUAST-K, Kargil, Ladakh,
India

Mohd Mehdi
Krishi Vigyan Kendra, Kargil-I,
SKUAST-K, Kargil, Ladakh,
India

Dorjay Namgyal
High Mountain Arid Agriculture
Research Institute, SKUAST-K,
Leh, Ladakh, India

First report on millets from Ladakh: A tribute to the celebration of International Year of Millets

Anwar Hussain, Rinchan Dolkar, Mohd Mehdi and Dorjay Namgyal

Abstract

Small millets viz. foxtail millet and proso millet are unattended but important crops cultivated in the pockets of the cold arid region, Ladakh. Due to the cultivation constraints and unawareness about the nutritional facts and health benefits the cultivation of the crops has been declined though it is used for feed and fodder purposes. The present study is an attempt to explore the status of the millets in the pockets of Leh and Kargil districts of Ladakh. It also brings in the various causes of the decrease in acreage under millets and the various possible remedies to be evolved to review its production and for the sustenance of the farming families affiliated. The revival of millets is also strongly felt for human consumption among the nutritionally deprived tribal population and the current study would be a tribute towards the celebration of 'International Year of Millets' in 2023 from this remotest region of the world.

Keywords: Millets, foxtail millet, proso millet, cha, tse-tse, chabras, chakhur, chatruk, Ladakh

Introduction

Year 2023 has been endorsed by Food and Agriculture Organization and approved by United Nations General Assembly as the 'International Year of Millets' proposed by India and supported by 70 nations. The aim is to increase awareness of the health benefits of millets and their suitability for cultivation in tough conditions (Food and Agriculture Organization, 2022) ^[1]. India is the world's largest producer of millets however analysis of data indicates a steady decline in area of millets other than finger millet. After 'Green Revolution' these climate smart crops were replaced by water intensive paddy. There is a growing interest in reviving millets in the country owing to their ability to survive in changing climatic conditions while providing high nutrition and better health. The millets have been reported to be special crops because of their ability to cure and manage prevalent lifestyle diseases like diabetes, hypertension, hyperthyroidism, cancer, etc.

In Ladakh only two types of small millets i.e. foxtail millet (*Setaria italica*) and proso millet (*Panicum miliaceum*) are grown. The foxtail millet is the second most widely cultivated species of millet after pearl millet and the most grown millet species in Asia. It is also one of the world's oldest cultivated crops. Proso millet is domesticated in Asia and Europe. The millets are traditionally cultivated in some pockets of both Leh and Kargil districts of Ladakh region, where double-cropping is possible (Fig. 1). These crops are generally grown as second crop after the harvesting of barley or wheat in warmer areas of the region. Locally foxtail millet [Fig. 2(a) and Fig. 2(b)] and proso millet [Fig. 3(a) and Fig. 3(b)] are known as *cha* and *tse-tse*, respectively. Foxtail millet is further categorized on the basis of seed color known as *cha-kar* (white seeded) and *cha-mar* (red seeded). In Leh district, the area under cultivation of other millets (buckwheat, foxtail millet and proso millet) which was 622 ha in 2013-14 got decreased to 553 ha in 2016-17 (Anonymous, 2017) ^[2]. The area under cultivation of the same category in Kargil district was reported to be 20 ha in 2019-20 (Anonymous, 2020) ^[3]. The small millets which were earlier important sources of nutrition are now under under-utilization.

Materials and Methods

Ladakh region is administratively divided into Leh and Kargil districts. Leh is situated approximately between 32°N to 36°N and 75°E to 80°E and Kargil is situated between 30°N to 35°N and 75°E to 77°E with elevations range from 2900 to 5800 m and 2400 to 7010 m amsl, respectively. The region covers an area of 59,146 Km² (Humbert-Droz and Dawa, 2004) ^[4]. Ladakh is bordered by the Tibet (China) to the east, the Indian state of Himachal Pradesh to the south, both the Indian-administered union territory of Jammu and Kashmir and the

Corresponding Author:
Anwar Hussain
High Mountain Arid Agriculture
Research Institute, SKUAST-K,
Leh, Ladakh, India

Pakistan-administered Gilgit-Baltistan to the west, and the southwest corner of Xinjiang (China) across the Karakoram Pass in the far north. As per the census 2011, Ladakh region constitutes 242 villages with a population of 274,289. Religion-wise population of Ladakh constitutes, Islam (mainly Shia) with 46% of total population, Buddhism (mainly Tibetan) with around 40% and Hinduism with 12% and other religions are less than 1% (PopulationU.com., 2022) [5]. Ladakh is a land abounding in awesome physical features, set in an enormous and spectacular environment characterized by extreme climatic conditions such as intensive sunlight, fluctuating temperature, high evaporation rate and strong winds (Tamchos *et al.*, 2011; Hussain *et al.*, 2022) [6, 7]. The region remains landlocked from outside world due to heavy snowfall over high mountains during winter for about five months in a year. The survey on identification and utilization pattern of underexplored millets was conducted in double cropped areas of the Leh and Kargil districts. Dha and Hanu villages of Leh district and Darchiks, Garkhon, Shiliktse, Poyen, Minjee and Gongma Kargil villages of Kargil district were purposively selected for the current study. The investigations were made through field visits, questionnaires and interviews with elderly people regarding the past and present status of cultivation and consumption of millets.



Fig 1: Standing crop of foxtail millet in open field



Fig 2a: Foxtail millet



Fig 2b: Foxtail millet grains



Fig 3a: Proso millet

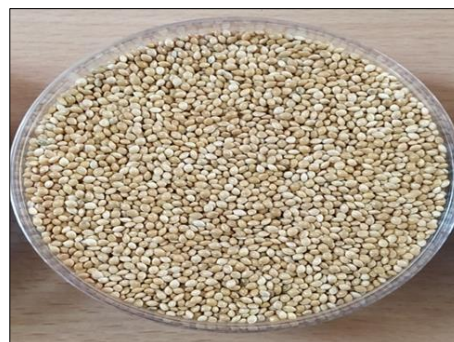


Fig 3b: Proso millet grains

Results and Discussion

The details of the present investigation carried out to study the status of millets in the high altitude cold arid zone of North Western Himalayas is presented here under.

Importance of millets in the study area

Since cropping season of the study area is of slightly longer duration than rest of Ladakh due to warmer weather condition and crops like buckwheat, turnip, local pea, etc perform well as second crop. Likewise millets are also short duration crops (2-3 months), fits well in this very zone. Sowing of seeds of millets is done simultaneously with the harvesting (uprooting) of barley which is the main crop of the area. Being one of the quickest growing cover crops taking only 4-5 weeks from seeding to flowering thus suppresses weeds and prevents soil erosion due to intensive runoff. Since millets matures quickly, these escape early autumn frost injury. Due to hardy nature of the crops and special climatic conditions, there is no report of disease infestation and pest attack. Traditionally millets are grown for human as well as livestock consumption from generations. The flour made from grains of foxtail millet is locally known as cha phey and that of proso millet as tse-tse phey. Dishes like paba, kholaq, chabras, chang, chathuk, chakhur, etc. are prepared from millets. Plants at green stage as well as after harvesting are used as fodder and the seeds are important source of cattle feed. However at present stage, human consumption of millets is declined. Overall the cultivation of these crops has been abandoned due to low yield, laborious threshing and lack of knowledge regarding their nutritional importance and health benefits.

Traditional cultural practices

Millets are grown in a traditional way and the special cultural practices have been developed by these ethnic communities as per their requirements. Seeds are broadcasted in the field

having previous standing crop. After that seeds got mixed with soil at the time of uprooting of the first crop. Seed sowing is also done by ploughing after broadcasting of seeds. Ploughing is done on a pair of *dzo* (a crossbred of cow and yak). Due to high germination value of these crops, the soil is early covered by the crop resulting in weed growth suppression as such weed control is not required in the said crops. The field is irrigated by artificial means with stream water diverted through channels. 10-12 irrigations are generally done throughout the life cycle of crop. Due to their hardy nature and special climatic conditions, these crops are devoid of any major insect/pest attack and disease infestation. The crop matures in about 3 months and is harvested soon after around 80% of its foliage turns yellowish in colour and the grain contains minimum moisture content which is detected by thumb method. The crop is harvested manually by uprooting method. After harvesting, the head is cut with a knife from the stalk and let to dry in open sun for about 10 to 15 days. The stalk is collected and stacked on rooftops to feed the livestock in winter season. Threshing is done manually by beating of the dried heads on floor with a stick. The properly dried seeds are stored for next season. The grains after complete removal of husk which is done in a *stun* (big stone or wooden pestle mortar) are ground into flour in traditional watermill known as *rantak* (Hussain and Hussain, 2014)^[8].

Nutritional and health benefits

Millets are more than just an interesting alternative to the more common grains. Foxtail millet contains 12.3% crude protein, 8% fiber, 0.47% ash, 2.38% fat, 75.2% carbohydrate, 3.3% minerals, 2.8 mg iron, 290 mg phosphorus and 31 mg calcium. The protein content was found to be (11.6% of dry matter) and was significantly rich in essential amino acids (leucine, isoleucine, and methionine) than wheat protein. Proso millet gives 356 Kcal per 100 gm. It also contains 4.9% fat, 80.1% carbohydrate, 2.2% crude fiber, 1.9% minerals, 0.8 mg iron, 206 mg phosphorus and 14 mg calcium (Amadou *et al.*, 2013)^[9]. The protein content of foxtail and proso millet is similar to that of wheat, but it contains no gluten and by itself is not suitable for bread making. The grain of millets is rich in phytochemicals, including phytic acid, which is believed to lower cholesterol, and phytate, which is associated with reduced cancer risk (Coulibaly *et al.*, 2011)^[10]. These health benefits have been partly attributed to the wide variety of potential chemopreventive substances, called phytochemicals, including antioxidants present in high amounts in foods such as millets (Izadi *et al.*, 2012)^[11]. Millets are gluten-free, therefore an excellent option for people suffering from celiac diseases often irritated by the gluten content of wheat and other more common cereal grains. Millets are also useful for people who are suffering from atherosclerosis and diabetic heart disease (Gelinias *et al.*, 2008)^[12]. Choi *et al.* (2005)^[13] reported that protein concentrate of Korean foxtail millet and proso millet significantly elevated plasma adiponectin and HDL cholesterol levels and caused major decreases in insulin levels relative to a casein diet in type 2 diabetic mice. Furthermore, proso millet also improved glycemic responses and plasma levels (Park *et al.*, 2008)^[14]. In addition, proso millet protein concentrate has protective effects against D-galactosamin-induced liver injury in rats (Ito *et al.*, 2008)^[15]. Park *et al.* (2008)^[14] concluded that proso millet protein could be a potential therapeutic intervention in type 2 diabetes. In the northern area of China foxtail millet has been

widely used as a nourishing gruel or soup for pregnant and nursing women and has been applied to food therapy. It has been recorded that millet has many nutritious and medical functions. Foxtail yellow seeded cultivars, medicinally used as astringent, digestive, emollient and stomachic. It is also used in the treatment of dyspepsia, poor digestion and food stagnancy in abdomen. White seeds are used in the treatment of cholera and fever while the green seeds are diuretic and strengthening to virility. It is rich in vitamins and minerals such as copper and magnesium.

Traditional dishes prepared from millets

Various types of traditional foods and beverages are prepared from millets which are discussed below.

Chabras

Foxtail millet grains are cooked in water with salt and spices along with pieces of meat. Cooking is done up to a thick consistency.

Chakhur

Bread prepared from foxtail millet flour is known as chakhur. Dough is prepared from the composite flour made up of foxtail millet flour, wheat flour and germinated wheat flour (tsaps). Bread made from the dough is baked on a hot flat stone. It is eaten as such or with milk, buttermilk and vegetable curry.

Chathuk

It is a soup made by boiling foxtail millet grains with meat pieces and is generally given to patients suffering from common cold. Salt and spices are also added to it.

Paba

Foxtail millet flour is cooked with water in a stone pot, *doltoq*, and stirred with a special wooden spatula known as *skya*. *Skya* is also used for making final shapes (pyramid shaped), *skyalag*. It is eaten with meat or vegetable curry and other dairy products. It is eaten either hot or cold.

Chang

Local beer prepared by the fermentation of foxtail millet grains with the help of yeast, *phab*. The brew is prepared in a wooden pot, *zem* and after maturation, the extract is kept for ageing. It is considered as one of the strong and tasty beer in Ladakh.

Kholaq

It is one of the most important dishes of Ladakh (Hussain *et al.*, 2022)^[16]. The roasted proso millet flour, *tse-tse phe*, is mixed with tea, buttermilk or local beer to a consistency, when it does not stick to the hand. It does not require cooking.

Chasrul

When roasted proso millet flour is added to tea up to a consistency thicker than soup, then it is called as chasrul. A small butter is also added to it. It is taken hot to keep the body warm during winter.

Tarsrul

When roasted proso millet flour is added to buttermilk up to a consistency thicker than soup, then it is called as tarsrul. It is generally taken during field works and travelling in summer.

Changsrul

When roasted proso millet flour is added to local beer up to a consistency thicker than soup, then it is called as changsrul. It is also taken during field works and travelling in summer.

Constraints

At present time, small millets are mostly cultivated for feed and fodder purpose however the area under cultivation is limited. These crops are also under under-utilization as food. The reasons behind these are discussed below:

- Lack of knowledge of scientific cultivation practices resulted in low yield.
- The cultivation of demanding crops such as buckwheat, pea, turnip, and lentil as second crop in double cropped areas of the region
- The availability of rice grains and wheat flour at subsidized rates under Public Distribution System (PDS) being provided by Govt. of India
- Consumer preferences for rice and wheat
- Lack of knowledge about the nutritional status and health benefits of the small millets.
- Difficulty in primary processing especially removal of husk from the seed
- The locals know about only few traditional cuisines prepared from millets which are also at a diminishing stage.

Strategies

- A need of technical intervention is strongly felt in the current situation. Laying up of demonstration plots in the millet growing areas is the need to set the improved agronomic practices for the crop to increase the yield at the reduced cost of cultivation.
- New and improved varieties need to be developed and tested against the prevailing climatic conditions along with maintaining and conserving the traditional vulnerable gene pool.
- Special schemes should be launched in other warmer areas of the region to attract the farming community for the cultivation of millets.
- The new and improved farm tools and machinery is to be developed to reduce the drudgery faced during post harvesting management especially during the removal of husk.
- The nutritive value and health benefits of the millets are to be popularized along with the awareness about the harmful effects of chemically loaded foods being imported from outside the region.
- The crops should be processed into various value added products along with the traditional ones in order to cope up with the problem of nutritional deficiency among the tribal population.
- The local youth as well as farm women/SHG's should be trained for development of processed products which could divert the mindset of people towards this sustainable source of income generation owing to the demand for local products in the market as well as from the tourism point of view (demand for local cuisines at hotels, restaurants, home-stays, etc.).

Conclusion

Keeping in view the nutritional quality of its grain and early

maturity and suitability of the crop for marginal lands, there is a need to revive its cultivation and human consumption in Ladakh. Intervention through scientific cultivation and value addition of these millets will help in their revival. The people of land locked Ladakh are nutritionally deficient during winter months due to insufficient availability of fresh fruits and vegetables and other essential commodities. The case of anemia is prominent among the women folk. These problems can overcome with the utilization of highly nutritious crops like millets. The consumption of millet based foods will help in prevention of many lifestyle diseases such as cancer, diabetes, hypertension, obesity, etc. which have now become prominent in recent years in this remotest region of the world. Relatively low demanding crops and no report of any disease and pest attack these crops can be thus could be a promising candidate towards the organic farming.

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