ISSN: 2279-0454

Vol. 13, No. 2

April 2025 - June 2025

CAU

Farm Magazine

Directorate of Extension Education
Central Agricultural University, Imphal, Manipur

ISSN: 2279-0454

2279-0454

CAU Farm Magazine

Vol. 13, No. 2

April 2025 - June 2025

Published by:
Directorate of Extension Education
Central Agricultural University, Imphal
Manipur - 795 004

For any queries and advertisement contact:
Chief Editor *CAU Farm Magazine*
Email: dee_cau@yahoo.co.in

Layout & Design

Y. Premchand Singh
Computer Operator, DEE, CAU, Imphal

Technical Assistant

G. Amritkumar Sharma, Kh. Saratkumar Singh, Y. Sanjoy Meitei, W. Khagemba Singh, Mrs. Narita L., O. James Singh, Th. Ningthou Singh & R.K. Sandeep

Pages in the Magazine: 41

From the Editor's Desk

Prof. Ph. Ranjit Sharma
Director (Extension Education)

CAU Farm Magazine has long served as a vital platform for bridging the gap between agricultural research and farming communities across the North Eastern region. The articles published in this edition are carefully curated to address practical challenges faced by farmers while showcasing innovative solutions and success stories. Each contribution aims to inspire, inform, and enhance the decision-making capabilities of our readers from researchers and extension personnel to grassroots farmers making the magazine a dependable companion in their agricultural journey.

We extend our sincere appreciation to our Hon'ble Vice-Chancellor, Central Agricultural University, Imphal, Dr Anupam Mishra for his continued support and visionary leadership in bringing this publication to life. Under his guidance, numerous transformative initiatives have been implemented across the university, strengthening our extension outreach and research impact. His emphasis on promoting climate-resilient agriculture, doubling farmer income, skill development, and fostering collaboration among institutions has enriched the scope and reach of this magazine.

This edition of farm magazine covers a diverse range of topics in the agriculture and allied sectors. Readers will find insightful articles on integrated farming systems, sustainable livestock and poultry management, recent advances in horticulture, post-harvest technologies, and the role of digital tools in precision farming. Topics like Promoting millets : a journey to food and health security; Role of Nutrition in Poultry Production; Nutritional profile and Potential health benefits of Black Corn; Safflower: A versatile herb from ancient uses of modern health and others are emphasized.

We warmly welcome feedback and suggestions from our readers, which are invaluable for the continuous improvement of this publication. We also take this opportunity to sincerely thank the editorial team, contributing authors, and staff of the Directorate of Extension Education, CAU Imphal, for their dedicated efforts in compiling and publishing this magazine. Together, let us continue to nurture knowledge and growth in the agricultural landscape of the North East.

(Prof. Ph. Ranjit Sharma)
Chief Editor

April 2025 - June 2025

CAU Farm Magazine (Vol. 13, No. 2)

CONTENTS

ISSN : 2279-0454

NUTRITIONAL PROFILE AND POTENTIAL HEALTH BENEFITS OF BLACK CORN: A THOROUGH OVERVIEW

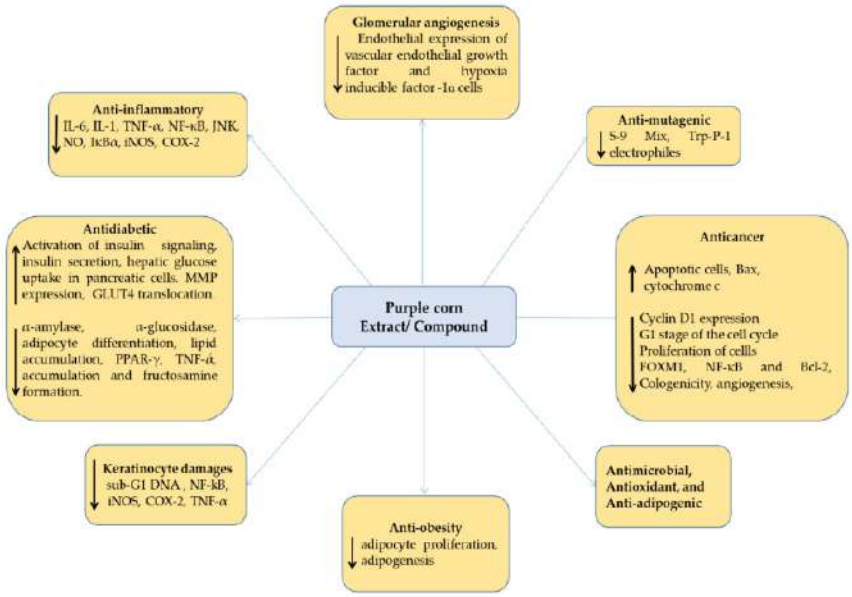
Saiba Siddiqui, Osi Siram, Bhargav Kalita, Punabati Heisnam, S. Dayananda Singh and Y. Linthoingambi Devi
College of Agriculture, Central Agricultural University, Iroisemba, Imphal-West: 795001

Introduction

Black corn (*Zea mays* L.) is an annual cereal crop, that belongs to the family Poaceae. This black corn is a group of flint maize varieties (*Z. mays* var. *indurata*; which is also known as Indian corn or calico corn) descended from a common ancestral variety called as "k'culli" in Quechua. Black corn is originated in Peru and getting huge popularity in the markets of Asia, the United States, and Europe. Being a medium sized variety of corn, each cob of black corn is generally about 15-30 centimetre long pending on the variety. It may show the colour white at the beginning when it is young but eventually develops a dark black-indigo hue that may show a lighter purple pigment throughout its body. It contains a chewy, starchy, sticky texture, which are often complemented by a sweetness that is milder than that of yellow corn. This colored corn for its unique appearance is extensively used in the preparation of traditional drinks and desserts as it adds a beautiful presentation to the dish. Hence the demand of black corn in food and food processing industries is gradually increasing, as its natural pigment is utilized in these industries for coloring beverages, jellies, and candies etc. In recent years, due to the presence of various bioactive compound, black corn has become particularly popular in pharmaceutical industries. Several studies have focused on purple corn varieties in recent times due to the presence of rich source of anthocyanin pigments in the aleurone or pericarp along with widely-Known health-promoting properties.

Nutritional value

Black corn contains anthocyanins; this pigment is responsible for its deep colour. Black corn also possesses some phenolics, carotenoids. These provides anti-inflammatory and antioxidant effect and hence it helps in reducing inflammation and protect the body from oxidative stress. Anthocyanins possess anticarcinogenic activity and hence it is valued for the role of cardiovascular disease prevention. Among the anthocyanins reported in black corn, cyanidin-3-O-glucoside is the most abundant. Purple Corn – CG3 – has the potential to control obesity and diabetes alleviation properties. CG3 is reported to be one of the most powerful antioxidants in existence, coming out top when tested against 13 other anthocyanins in the ORAC (oxygen radical absorbance capacity) assay, which tests for antioxidant activity. Natural antioxidants are found in many types of grain and maize. However, black maize is much higher in antioxidants; the levels of polyphenols and anthocyanins are dozens of times higher. Therefore, the muscles are much better protected, there is less damage to the muscle cells and the pigeons have more stamina and can thus fly longer. The anthocyanins content in colored maize can vary widely



due factors such as maize genetics, growing locations, part of the plant, extraction method, identification, and quantification (Harakotr *et al.*, 2014). In this context, studies have shown a range of anthocyanin content from 23 to 252 mg /kg in a survey with 398 genotypes of pigment corn (Paulsmeyer *et al.*, 2017) and from 12.8 to 93 mg cyanidin-3-glucoside (C3G) equivalents/g in 20 purple corn genotypes (Zhang *et al.,* 2019).

Beneficial health-related effects of non-anthocyanin phenolic compounds (e.g., quercetin, kaempferol, phenolic acids) that are present in black corn have also been extensively reported. It is rich in essential nutrients like iron, thiamine, riboflavin, and vitamin A and has many potential health benefits. This contributes the production of haemoglobin and prevents our body from anaemia. While presence of thiamine, riboflavin, and niacin act as key components in energy metabolism, which aid the body to efficiently convert food into energy. Magnesium present in black corn helps in muscle and nerve function. Phosphorus present in it is useful for the bone health. Black corn contains folate which support cell function and tissue growth especially in the periods of rapid growth , such as pregnancy. The presence of vit A content support to eye health, contribute to immune system and helps in promoting a healthy skin.

Utility

Generally black corn is not consumed raw. Corn-based foods require a thermal process prior to consumption. It tastes good while consumed by boiling, steaming, grilling and roasting. It can also be ground into flour, which can be used in preparing cornbread, tortillas, chips and Indian roti bread. In India it is mostly consumed as Bhutta, a grilled or roasted black corn served as a snack, similar to traditional corn and as roti popularly called Makka ki roti: Black corn flour is used to make a type of flatbread called makka ki roti, which is often served with vegetables, lentils, or meat. It can also be used in Indian breakfast items such as vada, upma. The boiled kernels can be sliced off the cob and used in salads, taco bowls, soups, and bean dips. It can be used in making a special dish called Peruvian pudding mazamorra morada in Peru. In India, Sagoo, a sweet porridge often served as a dessert can be prepared from it. From this variety of corn people can prepare delicious drinks such an example is Chicha Morada, which is a traditional drink made by black corn in Peru, since it is native to this place it has a great authenticity. In India, kanji is prepared in some parts, which is a type of fermented drink served as a refreshing beverage.

Mazamorra Morada: Special kind of Pudding

Black Corn Desert

Chicha Morada

Black Corn Salad

Extent

The exact origin of black corn is unclear but it is confirmed to be a variety grown by the Aztecs over 2,000 years ago and has been used since ancient times in areas throughout South America, notably Peru. This black maize was first developed in Peru and Chile.

Black corn is currently grown in several parts of the world, including South America, particularly in Peru, where it's known as Maize Morado. It's also grown in North America, specifically in Northern New Mexico, where a strain called Roberto's strain is cultivated. Additionally, Nepal is researching and studying the possibilities of growing black corn, with some organic farms some in the Surkhet district already cultivating it. In the United States, black corn is available in some special stores and is often referred to as Black Aztec corn or Black Mexican corn.

India is also exploring the potential of growing black corn. Black corn is currently grown in the North East region of India, where people have been actively cultivating and consuming these lesser-known varieties of colored corn. Specifically, states like Madhya Pradesh and Karnataka have the highest area under maize cultivation, with Bihar being the highest maize producer. Additionally, black corn is also grown in

ISSN : 2279-0454

other parts of India, including Maharashtra, Gujarat, Andhra Pradesh, and Tamil Nadu, where the soil and climate conditions are suitable for its cultivation.

Cultivation practices

The cultivation practice of black corn requires careful attention to soil, climate and pest management as well as specific considerations for seed selection, pollination and drying.

- Climate: Black corn requires warm temperatures to germinate and grow. It can thrive in temperate climates with moderate to high rainfall. (between 15^0 C and 25^0 C)
- Soil: Black corn prefers well-draining, fertile soil, with pH between 6.0 to 7.0. it can tolerate a wide range of soil types, but performs best in soils with good organic matter content.
- Sowing: Black corn is typically sown in the spring or early summer, when the soil has warmed up to at least 10^0 C sowing depth is usually around 2-3 cm (0.8-1.2 inch), and row spacing is typically around 60-90 cm (24-35 inch).
- Irrigation: Black corn requires adequate moisture, especially during the silking and tasselling stages. Irrigation is typically applied at a rate of around 500-700 mm (20-28 inch) per growing season.
- Fertilization: This crop is a heavy feeder just like the other maize crop and requires adequate fertilization. A balanced fertilizer applied at sowing, followed by side dressing of nitrogen at two splits.

- Pest and disease management: similarly to the traditional corn varieties black corn is also susceptible to various pests and diseases, including corn borers, aphids, and fungal diseases like rust and smut. Integrated pest management (IPM) practices, such as crop rotation, biological control, and chemical control, are typically used to manage these threats.
- Harvesting: Black corn is typically harvested around 100-120 days after sowing, when the kernels are mature and dry. Harvesting is usually done by hand or using a combine harvester.

Future Perspectives

In the last decade, the utilization of purple corn has increased steadily due to the presence of health-promoting anthocyanin compounds. Previous studies demonstrated that anthocyanin-rich purple corn extract showed numerous biological properties under both in vitro and in vivo conditions. In particular, purple corn extracts exhibited significant antioxidant, anticancer, anti-diabetic, anti-obesity, and anti-inflammatory potentials. The findings summarized in this review offer a basis for the development of novel strategies for functional food-related applications of purple corn anthocyanins. Although these in vitro and in vivo animal studies figure out the health benefits of purple corn extracts, mechanistic, bioavailability and clinical studies are warranted to confirm these effects. Furthermore, studies concerning efficient anthocyanin extraction methods are required to enhance the nutritional and health benefits of purple corn.

Conclusion

Mexican Purple Corn seems as promising crop of source for foods and beverages rich in amino acids (AAs). It is proven that black corn has a wide potential to be used with the aim of increasing anthocyanins' intake. In order to acquire its potential bioactive effects, this crop can be regarded as an option to increase the daily intake of this flavonoid. This cereal is an economical and sustainable source of nutrients, from which various food products that can meet the needs of consumers with specific health conditions and particular eating patterns having cultural relevance may be obtained. Nevertheless, further studies on the functional properties and nutritional features of purple corn are required. Although scientists had found that the anthocyanins concentration was affected by the foods and beverages preparation, the black Corn still provides an intake of 95 mg of TA day-1, which could be enhanced by optimizing the food and beverage manufacturing processes and by continuing the plant breeding of the germplasm to increase the anthocyanins' yield in the corn ear organs.

FLY DERMATITIS IN CATTLE OF SOUTH GARO HILLS DISTRICT, MEGHALAYA

Amarjit Karam, Athokpam Haribhushan, Rupam Bhattacharjya and Titus Dalang K. Momin
Krishi Vigyan Kendra, CAU(I), South Garo Hills, Chokpot, Meghalaya

Introduction

Flies are one of the most irritating ectoparasites of cattle around the globe and they can lead to severe negative impact on the productive performance of the cattle. They are characterized by having one pair of wings and they have complete metamorphosis with egg, larva, pupa and adult stages in their life history (TNAU, Agritech portal).Primarily there are three types of flies found in cattle viz. horn fly, face fly, and stable fly (Simmons,2018). Horn flies are Blood-sucking flies that feed on the cattle's blood and are prominently settled on the back, shoulder, and belly region. In contrast, face flies are non-biting flies that feed on secretion and are morphologically similar to house flies. Stable flies are also blood-sucking flies that feed on the legs of the cattle. Blood-sucking flies, such as horn flies and stable flies can cause severe stress and annoyance to cattle. "Fly worry" can lead to decreased weight gain and milk production because cattle spend time trying to avoid and remove flies rather than feeding (Halstead, 2025). The bites can even lead to severe dermatitis (a common skin condition characterized by inflammation & irritation of the skin) on the head and other body parts, resulting in a secondary infection and a high risk of disease spreading among the herd.Flies adversely affect the behaviour of cattle. Cattle can suffer from chronic irritation and pain from fly bites, which can have a negative impact on their welfare and behaviour as well as their daily activities, health, and productivity (Thaware, 2022). The problem may worsen during summer when the population increases and impacts cattle's weight and milk production. The fact that flies only contact animals for short periods of time is one of their most difficult traits (Kumar, 2011) in controlling flies in animals. Since actions must be taken at the exact correct time, adequate control can occasionally be challenging.

Occurrence of fly dermatitis in cattle of South Garo Hills

The present survey was undertaken in Bibragre village under Chokpot block, South Garo Hills districtwhich experienced a long spell of hot and humid summer season. Under this climatic condition, flies and other ectoparasites are very active and the severity of fly's infestation in cattle is very high in the peak of the summer season. The village has a sizeable nos. of cattle which are reared under free ranging system (or pasture system). In pasture system, horn flies are very common and they feast on blood meals every day on the shoulders, sides, and backs of cattle. On hot or rainy days, horn flies will move to the underside of the belly. Horn flies will mature to a reproductive adult in 10 to 20 days. Females will lay eggs in fresh droppings that are less than 10 minutes old. During the survey, several cattle in these villagesare foundto have mild to severe dermatitis on the neck and shoulder region which are being surrounded by biting flies.The skin lesions range from raised, dry, hairless and scab encrusted areas to severe open bleeding wounds. The lesions cause itching and cattle often scratch the affected parts to relieve irritation.Moreover, the cattle are found to be restlessness showing sign of severe discomfort due to biting by flies on the skin lesion.Farmers from other villages viz. Ashugre, Balwatgre, Jetra etc. also reported the occurrence of the same diseased condition in their cattle.

Fig. 1 Alopecia on the shoulder

Fig. 2 Ulceration on the shoulder (Hump sore)

ISSN : 2279-0454

Fig.3 Scab formation on the neck

Fig.4 Hyperkeratization (Skin Thickening) on the neck

Management

On understanding the prevalence of flies' infestation in cattle and their resultant problems in the affected animals, a team of KVK South Garo Hills staff including the subject expert (Livestock specialist) organised an animal health camp programme in the village to treat the affected animals. Around 20 animals with the skin lesion are brought to the camp for treatment. After properly restraining each animal, cleaning of the affected wound thoroughly (removing all the debris and dirt) was done with 0.01% potassium permanganate solution and then Himax ointment was applied to the wound for healing purpose. Long-acting antibioticinjection (Flobac SA) was given intramuscularly @ 1 ml/10 kg body weight to prevent secondary bacterial infection. Lastly fly repellent spray (Topicure spray) was applied around the affected area to control the flies and ivermectin injection was given subcuatenoeus @ 200mcg/kg body weight to kill the maggots that are present inside the wound. Similar health camps were organised in several villages viz. Asugre, Budugre, Gonggangre,Jetra, Balwatrge, Dagalgopgre, Warimagre etc. under Chokpot block to give treatment to the affected animals. Around 150 animals with the same diseased condition were given treatment. Besides conducting animal health camp, awareness cum training programme were also conducted in these villagesto impart the knowledge of basic animal health care & home remedy for livestock diseases to the farmers to minimize the problems and suffering of the affected animals.

Fig. 5 Himax Ointment application after cleaning the wound

Fig. 6 Fly repellent spray (Topicure) application to prevent from flies

Fig. 7 Awareness Programme on Livestock diseases and Management

Fig. 8 Training Programme on Livestock diseases and Management

Conclusion

Flies are a big nuisance causing problems to cattle health, welfare, and productivity, impacting weight gain, milk production, and more.The problem of flies is more in summer than in winter. They irritate the cattle causing pain and constant disturbance while feeding, resting, and other daily activities.Some measures to control flies in cattle are:

- Properly dispose of manure, rotting feed, and other organic matter that can serve as breeding sites for flies.
- Keep the surrounding environment clean and free of potential breeding grounds.
- Apply insecticide sprays or pour-on treatments directly to cattle to control adult fly populations.
- Rotate cattle between different pastures to break the fly life cycle and reduce breeding opportunities.
- Application of insecticidal ear tag.

LUPIN: FROM GARDEN BEAUTY TO PREMIUM CUT FLOWER

A. Sumalatha[1], V. Bhargav[2], T. Yatung[2], Akshay Kumar HM[1] and K.C. Sahoo[1]

[1]Scientist, ICAR- Indian Institute of Agricultural Research, Gogamukh, Assam

[2]Assistant Professor, MTTC & VTC, College of Agriculture, Pasighat, Arunachal Pradesh

Lupin (*Lupinus* spp.) is a vibrant ornamental flower crop belonging to the family Fabaceae. It is native to various regions, including the Mediterranean, North and South America, and parts of Africa. The genus *Lupinus* comprises over 200 species, with *Lupinus polyphyllus*, *Lupinus albus*, and *Lupinus angustifolius* being commonly cultivated for ornamental and other purposes.

The genus *Lupinus* comprises nearly 20 species, but among them, a few hold significant importance in ornamental horticulture. *Lupinus polyphyllus* is the most widely grown species for ornamental and cut flower production, valued for its striking spiky inflorescences available in a diverse range of colors, including blue, purple, pink, red, yellow, and white. Hybrid varieties, such as the renowned Russell Lupins, are extensively cultivated in gardens and for commercial floriculture. *Lupinus arboreus* is another species sometimes grown for landscaping, particularly in coastal areas, due to its high salt tolerance and flowers that range from yellow to blue. Additionally, *Lupinus mutabilis* is occasionally cultivated as an ornamental plant, appreciated for its uniquely attractive bicolored flowers, which add visual appeal to gardens and floral arrangements.

Lupin is gaining popularity as a new-generation cut flower due to its striking aesthetics, long vase life, and sustainable cultivation practices. Several factors contribute to its emerging status in the floral industry:

1. Unique Aesthetic Appeal
   - Lupins produce tall, spiky inflorescences with dense, colorful florets, making them ideal for floral arrangements and bouquets.
   - Available in a wide range of colors like blue, purple, pink, yellow, red, and white, catering to diverse market demands.
2. Extended Vase Life
   - Properly harvested lupin stems can last 7–10 days in a vase when placed in fresh water with floral preservatives.
   - The gradual blooming of flowers along the spike enhances their decorative appeal over time.
3. Sustainability and Eco-Friendliness
   - Under optimal conditions, a single lupin plant has the capacity to fix approximately 100–200 mg of nitrogen per day through its symbiotic association with *Rhizobium* bacteria. Over the course of a 90–120 day growing season, each plant can accumulate between 50 and 150 grams of nitrogen. When cultivated as a commercial crop, a well-managed lupin field has the potential to fix 100–250 kg of nitrogen per hectare, equivalent to 40–100 kg per acre. This substantial nitrogen enrichment enhances soil fertility, making it highly beneficial for the subsequent crop, as it reduces the need for synthetic fertilizers and promotes sustainable agricultural practices.
4. High Market Demand
   - Increasing preference for wildflower and cottage garden-style floral arrangements has boosted the demand for lupins.
   - Popularly used in weddings, events, and home decor, particularly in European and North American markets.
5. Versatile Use
   - Apart from cut flowers, lupins are also valued in landscape gardening, pollinator-friendly gardens, and as a potted ornamental plant.
   - Their tall and elegant structure adds height and dimension to floral designs.

The following methods outline effective ways to incorporate lupins into garden designs:

1. Mixed Flower Borders
   Lupins thrive in mixed borders, where they can be planted alongside roses, delphiniums, foxgloves, and irises, creating a classic cottage garden effect. By utilizing contrasting colors, such as blue lupins paired with yellow marigolds, a visually dynamic and vibrant floral display can be achieved.
2. Mass Planting for Visual Impact
   When planted in large clusters or drifts, lupins create a dramatic focal point in garden landscapes. Arranging them in odd-numbered groups (such as three, five, or seven) ensures a natural and

ISSN : 2279-0454

harmonious appearance, mimicking organic growth patterns found in nature.

3. **Vertical Interest in Garden Beds**
The tall stature of lupins makes them ideal for adding vertical interest to flower beds. When placed towards the back of the border, they provide structure and depth to the garden. Pairing lupins with low-growing perennials, such as lavender, alyssum, or petunias, creates a layered and visually balanced planting scheme.

4. **Pollinator and Wildlife Gardens**
Lupins serve as an important nectar source for bees, butterflies, and other beneficial insects, contributing to the promotion of biodiversity. To further enhance pollinator activity, they can be paired with echinacea, bee balm, and verbena, all of which attract pollinators and create a lively, nature-friendly garden space.

5. **Pathway and Entrance Planting**
The inclusion of dwarf lupin varieties along garden pathways provides a soft, colorful edging, adding a sense of elegance and cohesion to walkways. Placing lupins near garden entrances or archways helps establish a grand and welcoming aesthetic, drawing visitors into the space with their vibrant blooms.

6. **Seasonal Color Coordination**
To ensure continuous flowering throughout the growing season, lupin varieties should be selected based on their bloom times, complementing spring and summer floral displays. Mixing warm shades such as red, yellow, and orange creates a fiery and energetic ambiance, while cool tones like blue, purple, and white contribute to a serene and calming atmosphere.

7. **Container Gardening for Compact Spaces**
Dwarf lupins are well-suited for container gardening, making them an excellent choice for patios, balconies, and courtyards. When grown in large decorative pots, they offer flexibility in garden design. To enhance their visual appeal, lupins can be combined with trailing plants such as sweet alyssum or ivy, creating a multi-dimensional and artistic arrangement.

By thoughtfully incorporating lupins into garden landscapes, their ornamental beauty, structural elegance, and ecological benefits can be fully utilized, transforming any space into a vibrant, dynamic, and visually captivating floral haven.

Soil:

Lupins prefer well-drained, sandy-loam soil with a slightly acidic to neutral pH (6.0–7.0).

Ideal Temperature for Growth

It requires15–20°C for uniform seedling emergence and10–25°C i.e., cooler temperatures enhance plant vigor and flowering.

Propagation of Lupin

Lupin (*Lupinus* spp.) is primarily propagated through seeds, as vegetative propagation is not commonly practiced due to its deep taproot system. The seeds have a hard seed coat, which may require scarification (soaking in warm water for 12–24 hours) to enhance germination.

In plains, October to November (Winter sowing) is ideal for sowing, however, in hills March to April (Spring sowing) is congenial.

If sowing lupin in a protray, it is recommended to use trays with larger-sized holes than usual. This is because lupins develop a strong taproot system, which requires more space for root growth. Using deep-cell trays (such as 50-cell or 72-cell trays with larger holes) helps in:

- Preventing root curling and damage during transplanting.
- Allowing better root aeration and drainage.
- Ensuring stronger seedlings with a well-developed root system.

Germination and Transplanting

It takes 10-14 days to germinate after sowing. Seedlings willl be ready for transplanting after 4–6 weeks, once seedlings develop a strong root system and 3–4 true leaves.

Transplanting:

They should be transplanted carefully to avoid root disturbance, as they do not tolerate excessive handling due to their sensitive taproots. Alternatively, biodegradable pots or root trainers can also be used to minimize root disturbance while transplanting, as lupins are sensitive to transplant shock.

With a planting density of 40 cm × 40 cm, approximately 25,000 to 25,300 lupin plants can be accommodated per acre under commercial cultivation for cut flower production. Each plant typically produces three to four high-quality floral spikes, resulting in a potential yield of up to 100,000 cut flowers per acre. This high productivity, coupled with the plant's aesthetic

appeal and market demand, makes lupin a promising crop for commercial floriculture.

Harvesting:

For optimal quality and vase life, harvesting lupin spikes when the top two florets remain unopened is considered ideal. Harvesting should be done early in the morning or late in the evening to minimize moisture loss. Stems should be cut at the base with sharp tools, immediately placed in clean water, and stored in a cool environment before transportation.

Bent spikes are a common disorder in lupin, caused by phototropism when grown in partial sun. To prevent this, full direct sunlight is recommended for strong, upright stems and better flower quality.

Lupin seed

Lupin nursery in protrays

Potted plant

Lupin in vase arrangements

Harvesting stage

Lupin in mixed flower borders

ISSN : 2279-0454

FORMULATION AND QUALITY ASSESSMENT OF AMLA CANDY FOR ENHANCING THE ECONOMIC UTILIZATION OF AMLA IN EAST GARO HILLS OF MEGHALAYA

Dipak Das, Sanjarambam Nirupama Chanu, Yanglem Herojit Singh and Shah M. Hussain
[1]Krishi Vigyan Kendra, East Garo Hills, Meghalaya, CAU (I), Megagre, Meghalaya

ABSTRACT

The present study aimed to formulate and evaluate Amla candy as a value-added product to enhance the economic utilization of Amla (*Phyllanthus emblica*) in East Garo Hills, Meghalaya. Despite its abundance and nutritional richness, Amla remains underutilized in the region due to a lack of processing facilities and market access. Three treatments of Amla candy were developed: uncoated (T1), sugar-coated (T2), and spice-coated (T3). The candies were assessed for product recovery percentage and sensory qualities using a nine-point Hedonic scale. Results revealed that sugar-coated candy (T2) had the highest recovery percentage due to sugar infusion, while spice-coated candy (T3) achieved the highest sensory scores, offering a balanced flavor profile and better consumer acceptability. The findings underscore the potential of spice-coated Amla candy as a viable, nutritious, and shelf-stable product that can reduce post-harvest losses and generate rural employment. The study supports the commercialization of Amla-based products to boost income and promote sustainable agri-food practices in Northeast India.

INTRODUCTION

Amla (*Phyllanthus emblica*), or Indian gooseberry, is a fruit well-known for its high nutritional and medicinal value, particularly due to its abundant vitamin C, polyphenols, flavonoids, and antioxidants and it is abundantly available in East Garo Hills of Meghalaya during the season(Fig. 1). Amla has been utilized for its therapeutic benefits in traditional Indian medicine systems like Ayurveda for centuries, including its abilities to boost immunity, aid digestion, and regulate blood sugar levels. Although this fruit has great potential, its economic use is restricted in many areas of India, including Meghalaya in the northeast, where it grows plentifully in the wild and local orchards due to its suitable agro-climatic conditions. The fruit is mainly underutilized because of insufficient processing facilities, limited knowledge of value-added products and lack of access to organized markets. As a result, a large amount of Amla produced locally is wasted or sold for low prices generating little profit for local farmers. Therefore, the value addition of an Amla is an alternate way to improve its commercially viable, make product shelf-stable and acceptable to the consumers. The increased value not only earns extra profit, it would provide employment to rural communities and would bring sustainability.

Amla candy offers a promising value-added product that merges health benefits with consumer attractiveness. This processed food item is created by osmotically dehydrating pieces of Amla, then drying them and coating them with sugar or spices based on the desired flavor. Amla candy preserves many of the advantageous nutrients of the fruit and has a longer shelf life which makes it appropriate for mass production, storage and distribution. The flavor profile of sweet-and-sour is widely accepted among all ages indicating a considerable market opportunity at both local and national levels. To ensure that the product is safe, retains its nutrients, is acceptable to consumers and is competitive in the market, it is essential to formulate and assess the quality of Amla candy. This encompasses the assessment of the physicochemical properties percentage products recovery, organoleptic attributes (flavor, texture, smell, visual aspect) and microbial safety of the end product. Moreover, fine-tuning processing parameters like blanching time, sugar concentration and drying method can greatly affect the product's quality and profitability.

Keeping the above views, the present study was conducted to specify a standardized approach for producing high-quality Amla candy from locally sourced fruit in East Garo Hills, Meghalaya. The study

Figure 1: Freshly plucked Amla from the Amphangdamgre village of East Garo Hills, Meghalaya

aims to determine the feasibility of Amla candy as a value-added product that can aid rural livelihoods, decrease post-harvest losses and encourage sustainable use of local biological resources through systematic quality evaluation. This study connects traditional knowledge with scientific processing techniques to support the broader objectives of food innovation, economic development and agricultural sustainability in northeastern India.

MATERIAL & METHODOLOGY

Raw material procurement

Amla were procured from Ampangdamgre village of East Garo Hills, Meghalaya and stored at ambient condition before the experiments. The other raw ingredients like cane sugar were procured from the authentic sources.

Preparation of Amla candy

Amla candy preparation includes a number of processing steps based on scientific principles to improve shelf life and taste (Fig. 2 & Fig. 3). Briefly, around 1 kg of Amla fruits (30-35 pieces), which are fresh, mature and of high quality are chosen for their uniformity. The fruits are washed thoroughly with drinking water to remove surface impurities and contaminants. The cleaned Amla are then blanched by boiling them in water for 5-8 minutes at 75-80° C to soften the tissue, inactivate enzymes and ease seed removal followed b water cooling to stop the cooking process. Upon cooling, the fruits are pitted and sliced uniformly to guarantee even drying and sugar absorption. During the process, seeds also separated from the slices. The slices are immersed in sugar syrup made from 0.7 kg (or 3.75 cups) maintaining 58% TSS and kept for osmotic dehydration by soaking for 24 hours. This step facilitates the infusion of sugar and the reduction of moisture. After soaking, the Amla slices are drained and dried under the sunlight until they reach the desired moisture content, thus preventing microbial growth and spoilage.

In the present study three treatments were used viz.T1: Amla candy without coating; T2: Amla candy with sugar coating and T3: Amla candy with spice coating and their percentage product recovery and quality were assessed through sensory evaluation using a nine-point Hedonic scale.

The sensory attributes of the dried slices can be enhanced by optionally coating them with extra sugar or food-grade spices. To preserve quality while being stored and distributed, the finished product is placed in air-tight moisture-resistant containers.

Percentage Products recovery

The percentage recovery of the final product (Amla candy) was determined by weighing the final dried candy and comparing it to the initial weight of raw Amla used (Pavitra et al., 2021). This enables the calculation of product yield or recovery percentage, which is a key factor in evaluating process efficiency. The recovery rate was calculated with the help of equation 1.

$$\text{Percentage recovery (\%)} = \frac{\text{Weight of final candy}}{\text{Weight of raw Amla used}} \times 100$$

Figure 2: Steps of Amla candy preparation.

Figure 3: Making of Amla Candy with the farmers of Amphangdamgre village by KVK- East Garo Hills

ISSN : 2279-0454

Quality assessment through sensory evaluation

A sensory evaluation of the Amla candy was conducted by ten semi-trained panelists who had experience consuming high-quality candy (Sohshangrit *et al.,* 2022). Using a nine-point Hedonic scale ranging from 1 (strongly dislike) to 9 (like strongly), the panelists evaluated the sensory attributes of each sample, including taste, color, odor, appearance, mouthfeel, and overall acceptability. The sensory panelists used self-explanatory questionnaires to give their results for the sensory parameters evaluated for each sample. Before and after the assessment, the panelists had potable bottled water available to rinse their mouths.

RESULTS AND DISCUSSION

The recovery percentage of Amla candy differed among the three treatments, underscoring the effect of post-processing adjustments on final yield. The sugar-coated Amla candy (T2) demonstrated the highest recovery percentage among the samples, due to the extra weight from the sugar coating (Fig. 4). This observation is consistent with findings from Sohshangrit *et al.* (2022), who noted an increased yield in sugar-coated Amla candies resulting from sugar infusion during osmotic dehydration. Conversely, the uncoated candy (T1) exhibited the lowest yield, probably because it lacked any additive that could improve the mass of the final product. The sample coated with spice (T3) exhibited a moderate recovery, indicating that although the spice coating enhances flavor complexity, it does not substantially add to the product's weight when compared to sugar. The findings highlight the practical advantage of sugar coating, which enhances flavor and improves processing efficiency regarding product yield.

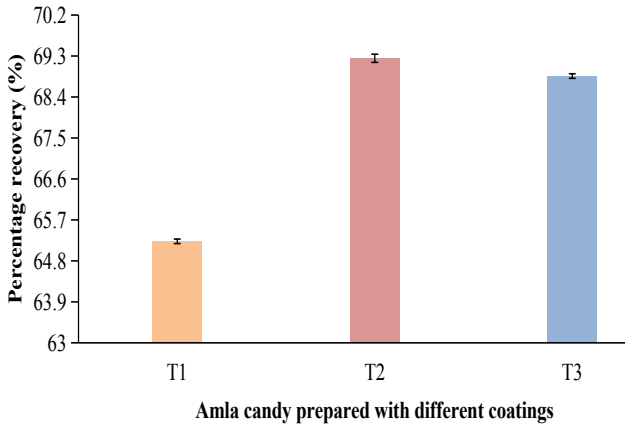


Figure 4: Percentage recovery of prepared Amla candy (T1: Amla candy without coating; T2: Amla candy with sugar coating; T3: Amla candy with spice coating)

The results of sensory evaluation confirm the superior quality of T3 sample (Table 1). The panelists evaluated all sensory parameters, including appearance, texture, flavour and overall acceptability of each sample. Spice-coated candy offers a complex blend of sweet, sour, spicy and tangy flavors which complements the naturally astringent and sour taste of Amla that enhanced the overall eating experience. Spices like black pepper, amchur powder and black salt stimulate salivation and improve mouthfeel which made the candy more enjoyable and refreshing. Moreover, black pepper is associated with the digestive and medicinal benefits that may attract more health conscious consumer towards the spicy Amla candy (Bell et al., 2017). The results align with those of Sohshangrit et al. (2022), who showed that the sensory properties of Amla candy are greatly affected by spice concentration and coating thereby increasing its acceptability. The candy coated with sugar (T2) was valued for its sweet taste, especially by panelists familiar with sweet fruit products. Nevertheless, its acceptability was somewhat lower than that of T3, probably due to nature of sugar that generally masks the natural flavor of Amla rather than enhancing it. Conversely, the uncoated Amla candy (T1) garnered the least positive evaluations. Its pronounced sourness and absence of additional flavor rendered it less pleasurable for those unacquainted with Amla's inherent taste.

These findings indicate that the kind of coating used is vital for ascertaining both the sensory attractiveness and the effectiveness of candy processing. The formulation of spice-coated Amla candy proved to be the most promising, providing the best balance between product recovery and consumer acceptance. This product has a strong potential for commercialization due to its simplicity, cost-effectiveness and use of locally sourced raw materials. It can act as a practical value-added product to boost the economic use of Amla in Meghalaya, potentially helping to decrease post-harvest losses, increase farmer income and foster the growth of rural food-based enterprises.

Table 1. Sensory evaluation of prepared Amla candy.

Parameters	T1	T2	T3
Appearance	7.9 ± 0.5^{a}	8.8 ± 0.5^{a}	9.0 ± 0.6^{a}
Texture	7.8 ± 0.7^{a}	8.1 ± 0.3^{d}	8.8 ± 0.2^{b}
Flavor	7.4 ± 0.9^{b}	8.5 ± 0.8^{b}	9.2 ± 0.5^{a}
Overall acceptability	7.1 ± 0.4^{c}	8.2 ± 0.5^{c}	9.1 ± 0.3^{a}

(T1: Amla candy without coating; T2: Amla candy with sugar coating; T3: Amla candy with spice coating; similar superscript along with '±SD› in the column indicate no significant difference).

ECONOMIC ANALYSIS AND LIVELIHOOD POTENTIAL

In the East Garo Hills region, the local market price of fresh Amla is approximately Rs. 20-25 per kg, while 1 kg of value-added Amla candy can be sold at Rs.250-300/ kg depending on the flavor, packaging, and quality. The product recovery rate ranges between 30-45%, meaning approximately 2.5-3.3 kg of fresh Amla is required to produce 1 kg of candy. Based on the total production cost, approximate profit margin from a kg of Amla candy can be 45-50% i.e. Rs.125-150. Further, for a small-scale rural unit producing 10 kg of candy/day, the daily profit could be approximately Rs.1,200-1,500, translating to Rs.30,000-40,000 per month, depending on scale, market linkage, and efficiency. The initial capital investment for setting up a small processing unit includes: raw Amla: Rs.600-725, stainless steel utensils and equipment: Rs.10,000, hygienic workspace setup: Rs.15,000, packaging materials: Rs.5,000 and miscellaneous and working capital: Rs.20,000 i.e. total initial investment of Rs.50,000-55,000.

CONCLUSION AND FUTURE SCOPE

The research showed that among the tested formulations, spices coated Amla candy provides the moderate product yield but the best combination sensory quality and consumer acceptability. This uncomplicated and inexpensive procedure has significant promise for small-scale rural enterprises in East Garo Hills of Meghalaya, as it provides a means to diminish post-harvest losses and enhance the economic value of locally sourced Amla. Future work can focus on improving the nutritional profile using natural sweeteners or functional additives, optimizing drying techniques and conducting broader consumer studies to refine the product further. Amla candy has the potential to become a sustainable and marketable product that benefits local communities and drives regional food innovation, given continued research and support.

PROMOTING MILLETS: A JOURNEY TO FOOD AND HEALTH SECURITY

Khumlo Levish [1*], A. Ameeta Devi[1] and Y. Prabhabati Devi[2]
[1]ICAR-Krishi Vigyan Kendra, Chandel, ICAR-RC for NEH Region Manipur Centre,
[2]Krishi Vigyan Kendra, Imphal East, CAU, Imphal Manipur

Introduction

In Indian agriculture, millet holds significant importance, having been cultivated for thousands of years. The word "millet" refers to a group of small-seeded grasses in the Poaceae family, including sorghum, finger millet, pearl millet, foxtail millet, and little millet, that are mostly grown as grain crops on marginal land in arid regions. With regard to food security, nutrition, cultural importance, livelihoods, and environmental sustainability, it is a crucial crop for Indian agriculture and society. The only crop that will help with future food, fuel, malnutrition, health, and climate change concerns is millets. Millets grow well in poor soil because they are suited to a variety of ecological situations that require less water and other inputs. There are nine types of Millets grown in India. The major millets are Sorghum, Pearl Millet, and Finger Millet covering 95% of the total millet growing area in India and the rest 5% are Little Millet, Foxtail Millet, Barnyard Millet, Proso Millet, Kodo Millet, and Brown top Millet.

Importance of growing millets

Nutritional Importance of Millets

- Now referred to as Nutri-Cereals, millet is the nutritional storehouse. When it comes to nutrition and health advantages, millets are special. Thus, millet is a miracle food. The grain with the highest iron content is pearl millet. It can treat anaemia in India and contains 4 to 8 mg per 100 gm of grain. It is advised for expectant mothers and is also high in zinc and folic acid. Protein in pearl millet is double that of milk.
- The potential of millets for treating and decreasing diabetes has been sufficiently demonstrated by the results of the current systematic review and meta-analysis of millets. Millets' low glycaemic index aids in the control of diabetes. The grain known as "Ragi" finger millet has the highest calcium

ISSN : 2279-0454

concentration, containing approximately 364 mg per 100 grammes. Three times as much calcium as milk is in it. The strong bones and teeth are maintained by this calcium-rich grain.

- Rich in dietary fiber, millets facilitate digestion and ward off constipation. Three times as much dietary fibre as wheat, maize, and ten times more than rice is found in kodo millet. Millets' high fiber content functions as a pre-biotic, supporting the maintenance of a balanced gut flora. Millets are excellent for those with celiac disease and are completely gluten-free. Antioxidants included in millets shield our cells from harmful free radicals.

- Millets have been shown in a recent study to lower the risk of cardiovascular disease. Losing weight is aided by millets. Millets provide unique nutrients that aid in weight loss, such as tryptophan, policosanols, and dietary fibre.

Importance of Millets in the Indian Agriculture Sector

Apart from health benefits, millets are resilient to climate change as they are adapted to a wide range of temperatures, and moisture regimes, and demand less input to grow. They are hardy crops that have low carbon & water footprints. It can sustain drought and even 350-400 mm of rainfall is sufficient for millets. Millets grow faster, putting less stress on the environment.

- The United Nations General Assembly adopted a resolution declaring 2023 as the International Year of Millets, as proposed by India to the Food and Agriculture Organization and the primary aim of this initiative is to increase the awareness of millets' health benefits among the people and their suitability for cultivation under tough conditions marked by climate change.

Importance of millets in the context of Climate Change

- In rice production, temperature increase are predicted to reduce rice yields. So, there is a need to consider adaptive measures to cope with changing agricultural patterns. Due to climate change, there is a decline in yield leading to food insecurity, more attacks of pests and diseases, soil degradation, change in crop schedules, and desertification. Considering, millets as an alternative crop is a better choice and we can say it is the future crop.

- Millets are C_4 carbon sequestrating crops contributing to the reduction of CO_2 in the atmosphere.

- Millets have a shallow root system and require minimal fertilizers, making them an environmentally friendly crop. They also act as a natural barrier against soil erosion, and their short growth cycle allows for crop rotation, which helps in maintaining soil health helping in Ecological Benefits.

Importance of millets in the Economics

- Millets are an important crop for small-scale farmers as they require minimal investment and have a low input cost. They also have a high market demand due to their nutritional benefits, making them a lucrative crop for farmers.

- To promote the cultivation of millets in India, the government has launched several initiatives such as the Millets Mission, which aims to increase the production and consumption of millets.

- Additionally, good farming systems for millets include inter-cropping with legumes, crop rotation, and the use of organic farming practices. These systems help in maintaining soil health, increasing yield, and reducing pest and disease infestations.

What are challenges in marketing and scaling up millet production

While there is growing interest in millets in India, there are still several challenges in marketing and scaling up millet production. Here are some of the main challenges:

- **Limited awareness and demand:** While there is a growing awareness of the health benefits of millet's, many consumers are still not familiar with millet's and do not know how to cook or consume them. This limits the demand for millet-based products and makes it difficult for farmers to sell their produce.

- **Lack of processing and storage infrastructure:** There is a lack of processing and storage infrastructure for millets, which makes it difficult for farmers to process and package their produce. This limits their ability to add value to their produce and sell it at higher prices.

- **Limited market access:** Millet farmers often face

limited market access, particularly in remote and rural areas. This can lead to low prices and limited demand for their produce.

- **Low productivity:** Millet productivity in India is often low due to a lack of access to quality seeds, fertilizers, and other inputs. This can limit the ability of farmers to scale up production and meet market demand.
- **Climate change:** Climate change is affecting millet production in India, particularly in areas that are already prone to drought and other weather extremes. This can lead to lower yields and quality, making it more difficult to market and sell millets.
- To address these challenges, there is a need for greater investment in millet processing and storage infrastructure, as well as efforts to raise awareness of the health benefits of millets among consumers.
- Additionally, there is a need for better access to quality seeds, fertilizers, and other inputs to improve millet productivity and scale up production. Finally, there is a need to develop new market linkages and value chains to help millet farmers access markets and sell their produce at higher prices.

Conclusion

Millet has played an important role in Indian agriculture and society for thousands of years. It is environmentally sustainable and can help to protect soil health, reduce water usage, and improve biodiversity. Millet is a low-input crop that requires minimal fertilizers and pesticides, making it a more environmentally friendly alternative to other crops.

Pear millet (Bajra)

Finger millet (Ragi)

Sorghum (Jowar)

Foxtail millet

Proso/Common millet

Kodo millet

Job's tear millet

Barn yard millet

Buckwheat millet

Fig: Some of the cultivated millets in India

ISSN : 2279-0454

BUCKWHEAT: PRODUCTION TECHNOLOGY AND AS SUPER FOOD FOR NORTHEAST INDIA

Bhargab Kalita, Osi Sinam, Saiba Siddiqui, Punabati Heisnam, Abhinash Moirangthem, Stina Khumukcham, Bidyapati Ngangom and Sourabh Sharma

College of Agriculture, Central Agricultural University, Iroisemba, Imphal-West: 795001

INTRODUCTION

Buckwheat (*Fagopyrum spp.*) is one of the most important pseudo-cereals grown in India, often referred to as a potential crop or future crop due to its ability to meet the increasing food demand, its tremendous nutritional benefits, and its pharmaceutical properties. It is one of the oldest domesticated crops, yet it was underutilized for years. However, it is now cultivated in every cereal-growing country around the world. Cultivated buckwheat (Fagopyrum spp. 2n=16) is a dicot belonging to the genus Fagopyrum in the family Polygonaceae. Buckwheat grain is botanically classified as an achene. In terms of structure, its endosperm is similar to that of cereals, featuring a non-starchy aleurone layer and a starchy endosperm, which distinguishes it from other non-cereal grains. There are many buckwheat species grown worldwide, but only 20 species are used in agriculture. The most commonly cultivated species are common/ sweet buckwheat (*Fagopyrum esculentum* Moench) and tartary/bitter buckwheat (*Fagopyrum tataricum*). Tartary buckwheat is also known as duck wheat. Its wild species are used as forage in Southern Asia and in traditional medicine. Among the two species, common buckwheat is cultivated at lower altitudes, whereas tartary buckwheat is cultivated at higher altitudes (Babu *et al.*, 2016). Common buckwheat is becoming increasingly popular in the Himalayan region due to its appealing taste and quicker growing cycle compared to tartary buckwheat. This crop is well-suited for various cropping systems due to its short growth cycle of 3–4 months and its strong resilience to low temperatures and water scarcity. It is regarded as a sustainable crop that plays a key role in the livelihood of millions of people in hill areas, especially as climate change presents new challenges (Babu *et al.*, 2016), such as extreme cold, lack of water, and low soil fertility.Common buckwheat has the potential for fixing atmospheric nitrogen and solubilizing native soil phosphorus and potassium. It is a multi-use crop, primarily cultivated to obtain grains for human consumption, livestock, piggery, and poultry feeds, as green manure, as a smother crop, and as a soil-binding crop. Additionally, buckwheat attracts beneficial insects, such as pollinators and natural predators, which help to control pests like whiteflies and aphids. This makes it a suitable insectary crop, often grown in strips to enhance pest management. Furthermore, it is a high-yielding honey plant, typically producing nectar during the morning hours.In the higher Himalayan region of India, at altitudes around 4500 meters above sea level, this crop is the primary agricultural product, occupying approximately 90% of the cultivated land as a sole crop. In northeastern India, buckwheat is widely cultivated in Sikkim and Arunachal Pradesh. It is also grown on a small scale in Assam, Meghalaya, Nagaland, and Manipur. In the high-altitude regions of northeastern India, buckwheat serves as a vital staple food where traditional cereal crops cannot thrive due to the cold temperatures. The versatile grain is consumed in various forms. The Monpa tribe from Dirang, Arunachal Pradesh, makes noodles from buckwheat flour, while other tribal communities in Arunachal Pradesh use the grain to brew local beer.Buckwheat is known by several regional names in northeastern India, including paphar (meetha paphar: F. esculentum and teeta paphar: F. tataricum) and khuster in Sikkim; phapar, demsi, and dhemchi in Assam; and jheem, kyap, brasma, chikaw, bherem, jamu, dunchung, and grunching in Arunachal Pradesh. It is called jarain in Meghalaya, wakha yendem in Manipur, and generally kuttu in Hindi. About 340 germplasm accessions of two cultivated species of buckwheat (F. esculentum: 294 and F. tataricum: 46) have been collected from northeastern India by ICAR-National Bureau of Plant Genetic Resources, with the highest number procured from Arunachal Pradesh. The FAO has identified 39 nutrition-sensitive and climate-resilient crops as "Future Smart Foods," which include buckwheat. Buckwheat flour has a higher protein content compared to common cereals. Its protein is rich in lysine and arginine, and it is gluten-free. It also contains dietary fibers, vitamins, resistant starch, phytosterols, fagopyrins, fagopyritols, and phenolic compounds. Buckwheat contains a variety of minerals, including magnesium, copper, phosphorus, manganese, iron, and calcium. Additionally, it is high in fiber. Due to its tremendous nutritional benefits, it is often referred to as a superfood. Therefore, increasing its production through proper agronomic practices is essential.

PRODUCTION TECHNOLOGY OF BUCKWHEAT IN NORTHEASTERN STATE OF INDIA.

Climatic and soil requirement

Buckwheat, especially common buckwheat, is a hardy crop that thrives in cool, moist temperate regions but can also germinate in dry areas. It grows best in temperatures between 24–26°C, with poor growth and lower yields above 30°C. Buckwheat is sensitive to high heat and drought but can recover with moisture, although maturity may be delayed. It can grow in various soils, including infertile and rocky ones, and prefers well-drained sandy soils with an acidic pH (down of 4.8). However, it does not perform well in saline or semi-arid regions. Adequate soil moisture is essential for good yields.

Varieties-

Common buckwheat

VL Ugal-7-Early-maturing variety (60-70 days),bold seed (2.5 g/100 seed weight) and high yield potential(13.35%),and high lyine (5.5%).

PRB-1-Variety containing high amount of calcium,potassium and sodium content.(44.54 mg,444.0mg,2.13 mg per 100 g respectively)

Tartary buckwheat

Himpriya, Himgiri, Sangle B-1

COMMON BUCKWHEAT

TARTARY BUCKWHEAT

Sowing time

Northeastern hills including Assam- **August-September** (**October-November** in Sikkim under intensive cropping system)(Joshi,1999 and babu *et al.*,2016)

Land preparation and tillage operation

The land should be thoroughly ploughed and leveled, with four to five ploughings followed by laddering for good tilth. The first ploughing is best done about a month before sowing. Buckwheat can also be grown under reduced tillage systems and is suitable for low-input and organic farming. While tartary buckwheat performs better under no-till conditions, common buckwheat requires a well-prepared seedbed with a crumb structure for optimal germination. Proper seedbed preparation involves disking, tilling, and rolling after harvesting the previous crop to conserve residual soil moisture.

Seed rate 35-40 kg/ha for grain crops and 50-60 kg/ha for vegetable or fodder crops.It may varies by genotype and condition. Over-seeding may result spindly plants, so thinning is advised.

Plant Spacing Planting geometry depends on soil,variety, and climate.

30 × 10 cm for common buckwheat and 40 × 10 cm spacing for tartary buckwheat.

Sowing depth-4-6 cm, deeper in drier condition.

Cropping system of buckwheat

High Himalaya (**Arunachal Pradesh**) Buckwheat-Fallow, Pea-Buckwheat, Potato-Buckwheat.

Lower Himalayan region and foot hills **Sikkim, Meghalaya, Assam, Manipur, Tripura, Nagaland**)

Potato-Buckwheat-Barley, Tomato-Buckwheat-pea, Potato-Buckwheat-Mustard/Lentil.

Nutrient Management

Buckwheat thrives in soils with poor fertility and has low nutrient requirements, often relying on residual soil fertility. It is prone to lodging in fertile soils, especially those with high nitrogen, which decreases lignin content and delays maturity. Buckwheat does not respond well to nitrogen fertilizers; hence, nitrogen should be applied based on soil test results. Phosphorus promotes early maturity and reduces lodging. A balanced application of nitrogen and phosphorus is ideal for higher yields. Buckwheat can fix atmospheric nitrogen, making it beneficial for organic farming.

ISSN : 2279-0454

BUCKWHEAT FIELD IN SIKKIM

In terms of fertilization, FYM, vermicompost, mustard cake, and poultry manure significantly boost yields. Inoculation with *Azotobacter* and *Azospirillum* also improves growth, yield, and soil quality. ICAR-NOFRI (Sikkim) recommends the application of Azophos seed treatment, mixed compost @ 5t/ha, and neem cake @ 0.5t/ha for obtaining good yields. Buckwheat can tolerate high-aluminum soils.

Weed management

Buckwheat, being a fast-growing crop, can naturally suppress weed growth due to the presence of phytotoxins like fagomine, 4-piperidone, and 2-piperidinemethanol. However, during the establishment phase, effective weed control remains a challenge. *Chenopodium album* is a common weed infestation in Sikkim. Therefore, weeding once at 20-30 DAS or before the 4-5 leaf stage is recommended, either by hand weeding or using a dryland weeder. The application of alachlor @ 1.50 kg/ha is also recommended.

Water management

Buckwheat requires significantly less water than cereal crops, making it an ideal crop for water-scarce, rainfed areas. It needs about 225-315 liters of water to produce 1 kg of seed, allowing buckwheat to thrive under drought conditions. While intermittent water application can reduce dry matter production and increase rutin content, supplemental irrigation does not significantly impact crop yield. It can tolerate drought well but responds positively to irrigation, particularly during the flowering and grain formation stages, for better yield and quality.

Diseases and pest management

Buckwheat is generally resistant to serious insect-pest and disease problems. However, it can be affected by pests like cutworm and aphids, particularly the melon aphid (*aphis gossypii*), which can cause yellowing, distorted leaves, and stunted shoots. Aphids secrete honeydew, promoting the growth of sooty mold. Several diseases including aster yellows caused by mycoplasma, rot due to *Botrytis cinerea*, root rot due to *Fusarium spp*, *botrytis spp* and *Rhizoclonia spp*, chlorotic leaf spot due to *Alternaria allernals*, stripple spot caused by *Bipolaris sorokiniana*, blight due to *Phyloplhora parasikha* and downy mildew caused by *Peronospora spp*.Viral attacks can also reduce plant height and grain yield. During storage, buckwheat is prone to weevils. Proper grain drying is required.

Insect management

- Aphids: Can cause yellowing, distorted leaves, and stunted shoots. Control through pruning, or spray with petroleum oil-based spray (7 ml/l) or neem oil (3 ml/l). Natural predators like syrphid flies and ladybird beetles help control aphid populations. or imidacloprid 17.8 SL @ 20.0 g a.i/ha or 0.3 ml/l may be applied.
- Stored grain pests: Weevils (rice, granary, and maize) can infest stored grains. Prevent infestation by properly drying grains, cleaning storage bins, and treating them with neem oil (5 ml/l).

Disease management

- Downy mildew: Affects younger leaves, causing defoliation. Control by ensuring good air circulation, removing infected debris, and treating seeds with *Trichoderma viride* @ 4gm/kg of seeds. Soil application of *Trichoderma viride* @ 2.5 kg mixed with 25 Kg FYM.
- Powdery mildew: Appears as white blotches on leaves and stems. Manage by selecting disease-free seeds and applying wettable sulphur (0.25%).
- Aster yellows: A phytoplasma disease causing

sterile, small flowers. Control by managing the vector (Aster leafhopper) using petroleum oil-based spray @ 7ml/l or neem oil (1500 ppm) @ 3ml/l.

- Stem rot: Causes brown spots on leaves and stem collapse. Manage by avoiding moist, shaded soils, using crop rotation, and spraying copper oxychloride (0.25-0.3%) in the initial stage of disease spread. For effective disease and pest control, proper field management and early intervention are key.

Harvesting and Threshing

Buckwheat is an indeterminate crop that requires swathing to minimize shattering losses, especially during harvesting. Shattering can result in a 20-25% yield loss, particularly in tartary buckwheat, which is more prone to this issue. Swathing should be done when 70-80% of the seeds have turned brown, ideally in the early morning or during foggy weather to reduce losses. Late harvesting is common at higher altitudes, while early harvesting occurs in mid- and low-altitudes. The harvesting period for tartary buckwheat (*F. tataricum*) is longer compared to common buckwheat (*F. esculentum*), as common buckwheat matures earlier than tartary buckwheat. Buckwheat typically matures 90–100 days after sowing, but this can extend up to 5 months in unfavorable conditions. Proper drying and storage are crucial to avoid rancidity and quick germination, with an optimal moisture content of 13% for long-term storage. Drying temperatures exceeding 45°C can damage the grains.

Yield

Well-managed buckwheat yields about 1000-1500 kg of grain per hectare.

BUCKWHEAT AS SUPER FOOD-

Buckwheat is economically important due to its high nutritional value, particularly its protein content (10-14%), which is higher than most cereals. It contains essential amino acids like lysine, threonine, tryptophan, and sulfur amino acids, making it a superior protein source. Buckwheat flour is gluten-free, beneficial for treating celiac disease. It also has a high-quality starch that aids in managing diabetes. The grains are rich in healthy fats (palmitic, oleic, and linolenic acids) and trace elements like zinc, copper, manganese, and selenium, making it a valuable quality food for health. Also, Buckwheat has medicinal properties due to compounds like rutin and fagopyrin. Rutin, found in high amounts in Tartary buckwheat, is used to prevent edema, treat hemorrhagic diseases, stabilize blood pressure, and has anti-carcinogenic properties. It is mainly found in the leaves and flowers of the plant. Fagopyrin, a photosensitizing compound in buckwheat, is used in photodynamic therapy for treating microorganisms and cancer. Buckwheat also contains copper, which helps in iron function and prevents anemia. Additionally, Tartary buckwheat is used in traditional medicines for treating livestock diseases and can be made into tea for lowering blood pressure and blood sugar.

TABLE- THE NUTRITIONAL CONTENT OF BUCKWHEAT PER 100 GM.

WATER	9.75 g
ENERGY	343 kcal (1435 KJ)
PROTEIN	13.25g
TOTAL LIPID (FAT)	3.4g
ASH	2.1g
CARBOHYDRATES	Not explicitly listed, but inferred by difference from other components
TOTAL DIETARY FIBER	10g
CALCIUM	18mg
IRON	2.2mg
MAGNESIUM	231mg
PHOSPHOROUS	347mg
POTASSIUM	460mg
SODIUM	1mg
ZINC	2.4mg
FATTY ACIDS,TOTAL MONOSARTURATED	1.04g
FATTY ACIDS,TOTAL POLYSATURATED	1.039g
OMEGA-6 (18:2)	0.961g
OMEGA-3 (18:3)	0.078g
ASPARTIC ACID	1.133g
GLUTAMIC ACID	2.046g
GLYCINE	1.031g

* **USDA Food Data Central**

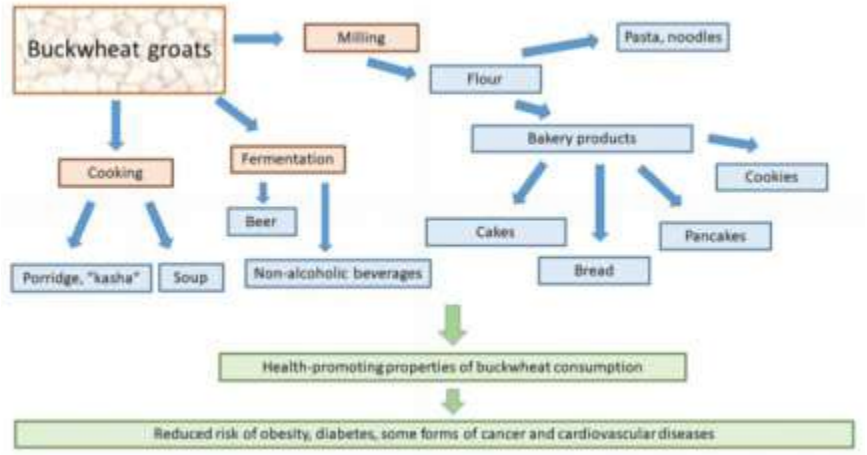
In Northeast India, buckwheat has various culinary uses. The tender leaves are used in chutneys and vegetable curries. The nectar of the plant is used to produce honey, particularly around sunrise. The seeds are popped and consumed as a snack. The monpa tribe from dirang, Arunachal Pradesh, makes noodles from buckwheat flour, while other tribal communities in Arunachal Pradesh use the grain to brew local beer .Buckwheat flour is commonly used during fasting

ISSN : 2279-0454

occasions and festivals, as well as in the preparation of bakery items, traditional breads, and pancakes. Tartary buckwheat leaves are used to make tea.

CONCLUSION

Buckwheat is an underutilized yet highly advantageous crop, especially in the North-east Himalayan region. It is resilient to climate stress, can thrive in poor soils, and has a short growing season, making it well-suited for high hill rainfed ecosystems. Buckwheat is also a potential crop for diversification in farming systems, offering numerous benefits such as high-quality protein, dietary fiber, and medicinal compounds like rutin and fagopyrin. Despite its advantages, challenges like the bitterness of Tartary buckwheat and dehulling difficulties need addressing through research and technology development.This crop is essential for tribal farmers in remote areas, providing a reliable protein source and supporting sustainable farming practices. Buckwheat is highly suitable for organic farming, rainfed systems, and zero-budget farming, while also playing a vital role in maintaining agro-ecosystems through water storage and soil erosion prevention. As a nutritious food source rich in starch, proteins, vitamins, and micronutrients, buckwheat can address nutritional deficiencies, especially in children and women. However, to prevent the decline in its cultivation, immediate attention from researchers, developers, and policymakers is needed to develop location-specific interventions and policies.



Buckwheat-based foods and their associated health effects.

SAFFLOWER: A VERSATILE HERBS FROM ANCIENT USES TO MODERN HEALTH

Osi Sinam, Punabati Heisnam, Bhargab Kalita, Abhinash Moirangthem, Bidyapati Ngangom, Stina Khumukcham and Saiba Siddiqui

College of Agriculture, Central Agricultural University, Iroisemba, Imphal-West

Introduction

Carthamus tinctorius L., commonly known as safflower or false saffron, is a member of the Asteraceae (Compositae) family. The genus *Carthamus* encompasses approximately 25 species, exhibiting a range of chromosome numbers, including 10, 11, 12, 22, and 32 pairs. Among these, *C. tinctorius*, with a chromosome count of 2n = 24, is the sole species cultivated extensively; the remaining species are predominantly wild or weedy in nature. Notably,

two wild species, *Carthamus oxyacantha* and *Carthamus palaestinus*, also possess 2n = 24 chromosomes. These species are closely related to cultivated safflower and are cross-compatible with it, as well as with each other. This genetic compatibility is significant for breeding programs, as it allows for the introduction of desirable traits from wild species into cultivated varieties. Understanding the chromosomal relationships and compatibility among *Carthamus* species is crucial for the conservation of genetic resources and the development of improved safflower cultivars. Safflower (*Carthamus*

tinctorius L.), a thistle-like annual plant in the Asteraceae family, thrives in arid climates, particularly in regions such as Southern Asia, China, India, Iran, and Egypt. It exhibits a bushy growth habit with upright, cylindrical stems and alternate leaves that are ovate to ovate-lanceolate in shape. These leaves may possess spines, leading to the classification of safflower into two varieties: spiny and spineless. Notably, the presence of spines has been associated with variations in oil content, with spiny varieties often exhibiting higher oil yields.The plant's branching system includes primary, secondary, and tertiary branches, each terminating in tubular flower heads known as capitula. These vibrant flowers, ranging in color from bright yellow to orange or red, are enclosed by spiny bracts. Safflower's root system is characterized by a deep taproot, extending over two meters, complemented by numerous thin lateral roots. This extensive root architecture enables the plant to access deep soil moisture and nutrients, making it well-adapted to arid environments.

It was introduced into western countries, such as Italy, France,Spain, and the United States during the 5th to the 14th centuries. The vernacular name of this plant in Iran is"Golrang", "Kajireh", and "Kafesheh", which has been vastly cultivated for its flower petals containing the red and orange pigments. The other well-known names for safflower are "Zaffer", "Fake Saffron", and Dyer's Saffron". It has been shown that the scavenging activities of safflower petals can produce a range of colors from orange to white with various intensities. Therefore, this plant is used for numerous culinary and textile purposes. With the advent of synthetic aniline dyes, it has been mainly grown as an oilseed and birdseed that has some applications in medicinal fields. More to the point, its oil has high nutritional value and consists of 70% polyunsaturated fatty acid (i.e., linoleic acid), 10% monounsaturated oleic acid, and mere amounts of stearic acid. Safflower remarkably shows purgative, analgesic and antipyretic characteristics, and is useful in patients with poisoning. This plant species is clinically associated with considerable outcomes for the treatment or management of menstrual cramps, post-partum hemorrhage, whooping cough and chronic bronchitis, rheumatism, and sciatica.The flowers of *C. tinctorius* are traditionally applied for cardiovascular, cerebrovascular, and gynecological complications. As for other biological activities linked to its water extract, it is regarded as an anticoagulant, vasodilating, antihypertensive, antioxidative, neuroprotective, immunosuppressive, anticancer agent with inhibitory impacts on the synthesis of melanin. Furthermore, it was indicated that safflower is effective for other ailments involving the neurotropic, cardiotropic, hemopoietic, and diaphoretic systems. Concerning the phytochemistry of this plant, pertained studies have pinpointed a number of active constituents, such as flavonoids, phenylethanoid glycosides, coumarins, fatty acids, and steroids identified from various parts of the plant.

Uses

Safflower oil is rich in poly unsaturated fatty acids as linoleic acid upto 78% which play an important role in reducing cholestrol content and its is a drying oil. It contains 24-35% oil. Itis also recommended for the heart patients.

- ✓ The hot oil poured in cooled water, it becomes a plastic of thickness and used for adhesive in glass industry.
- ✓ Safflower oil is the healthiest oil of all the

ISSN : 2279-0454

vegetables oil and its value is increased when it is blended with rice bran oil.

- ✓ The safflower cake is used as cattle feed contains 20% protein.
- ✓ Safflower was recognised as remedies for Rheumatism.
- ✓ Its dry petal is used in the preparation of herbal medicine and drugs also used to provide resistance to inflammation.
- ✓ It is used to as medicines for menstrual problems, cardiovascular complications as well as pain and swelling in trauma cases
- ✓ Its contains two colouring materials: water soluble yellow pigment "carthamidin" and orange red dye (2%) which is insoluble in water but readily soluble in alkaline solution known as "carthamin".
- ✓ Safflower is grown as border crop to protect the main crop of wheat in North India and is also green manure crop at young stage.
- ✓ The safflower cake is used as cattle feed which contains 20% protein but low in lysine. It is consume domestically and hardly enters International market.

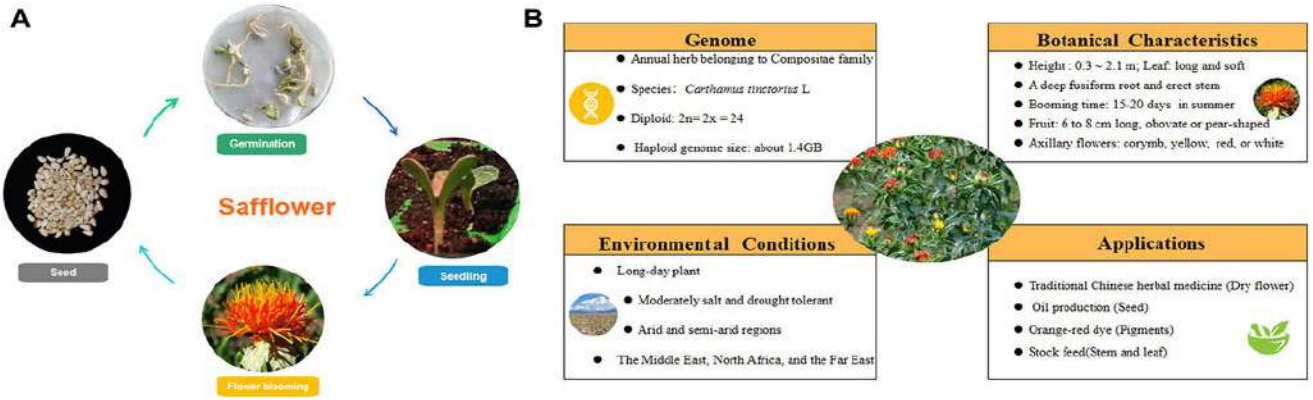


Fig: The biological characteristics and application of safflower. (A) the life cycle of safflower; (B) the characters of safflower

Importance

Safflower is a multipurpose crop giving quality oil, rich in polyunsaturated fatty acids, which help reduce cholesterol levels in the blood, and producing brilliantly colored flowers which are used as a source of natural dyes for food and fabrics. In addition to meeting our energy and aesthetic demand for coloring food and fabrics, different parts of the safflower plant also have medicinal properties and are useful in treating many chronic diseases.

1. **Plant as leafy vegetables**: In India, Safflower plants are consumed as a leafy vegetable at the tender stage. They are rich in vitamin A, calcium,iron and phosphorus. In regions where safflower is cultivated, particularly in India and neighboring countries, young seedlings are commonly bundled and sold in rural markets. These tender shoots are valued as a leafy vegetable, rich in nutrients and their availability in local markets highlights safflower's versatility beyond oil production, serving both nutritional and economic roles in these communities.

2. **Safflower as seeds**: Safflower seeds are diuretic and tonic which also helps in reduction of blood pressure. Safflower seed are highly nutritional and medicinal properties that attributed large amounts of bioactive compounds and essential fatty acids. Safflower seeds offer several health benefits, such as supporting muscle system,

memory process and immune function. They can also help prevent anemia, relieve period cramps, and potentially boost sexual health. Additionally, safflower seeds are rich in vitamin E and unsaturated fatty acids, which benefit skin health.

3. **Safflower oil:** Safflower oil is the richest in polyunsaturated fatty acid (linoleic acid, 77%). It has health-promoting properties since the 1960s, particularly due to its high linoleic acid content that lower serum cholesterol levels, potentially reducing the risk of heart disease. Beyond its fatty acid profile, safflower oil contains N-(p-coumaroyl) serotonin (CS), a potent antioxidant compound. CS has demonstrated anti-inflammatory and cardioprotective effects suggesting potential benefits for vascular health.This compound expresses unique growth-promoting activity for mouse and human fibroblasts. It is proposed that the growth-promoting effect of CS may not result from its antioxidant activity, since both antioxidative activity and an inhibitory effect of CS on proinflammatory cytokine production from human monocytes.

4. **Safflower as flowers**: Safflower flowers are regarded as stimulants, sedatives, and emmenagogues. Safflower flowers dilate arteries, reduce blood pressure, increase blood flow, and thereby promote oxygenation of tissues. Safflower has also been produced for its use as a dye, yielding red and yellow pigments with the crop commonly known as dyer's saffron. In Japan, safflower dye used on silk was reserved for women of high rank. Safflower has great potential to be used for both freshly cut and dried flowers and its exploitation in European floriculture. the varied usage of safflower has helped to increase monetary returns from the crop, thereby imparting greater sustainability.

Nutrient quality of Safflower

Safflower seeds (*Carthamus tinctorius* L.) are nutritionally rich, offering a substantial amount of protein, healthy fats, and essential minerals. They are particularly high in polyunsaturated fats, especially linoleic acid, an omega-6 fatty acid beneficial for heart health. Additionally, safflower seeds provide vitamin E and antioxidants, contributing to overall wellness. The oil extracted from these seeds retains these healthful properties, making it a valuable component in a balanced diet.

1. Protein: Safflower seeds contain a good amount of protein, ranging from 21.0% to 29.7%.
2. Fat: They are a good source of fat, with a range of 1.1% to 2.8%. Safflower oil, in particular, is rich in linoleic acid, an essential fatty acid.
3. Vitamins: Safflower seeds contain riboflavin, vitamins A and C, and Vitamin E.
4. Minerals: They are rich in iron, phosphorus, calcium, magnesium, potassium, and sodium.
5. Carotenoids: Safflower seeds are also rich in carotene.
6. Iron: Safflower seeds are a good source of iron, with a range of 3.42 to 55.1 mg/100 g.
7. Phosphorus: They are also a good source of phosphorus, with a range of 175 to 250 mg/100 g.

Safflower for consumption

Safflower is consumed in various ways, primarily through its oil and seed. The oil is used for cooking, salad dressings, and margarine production, while the seeds are consumed as birdseed or in animal feed. Safflower petals can also be used as a natural food coloring and flavorant.

1. By cooking**:** The most common use of safflower is in the form of safflower oil, which is extracted from the seeds of the plant. The refined safflower oil is used for frying, sautéing, and salad dressings due to its mild flavor and high smoke point. It's often used as a healthier alternative to saturated fats like butter or coconut oil. Cold-pressed safflower oil is rich in unsaturated fats, especially oleic acid (monounsaturated) or linoleic acid (polyunsaturated) depending on the variety.
2. By seed: Safflower seeds can be added to food products like pelleted products or used as a food additive. Safflower seeds are consumed primarily for their oil, which is used in cooking, industry, and as a source of birdseed. Whole safflower seeds can

ISSN : 2279-0454

also be eaten raw or toasted, especially in Middle Eastern cuisine, or as part of birdseed mixes. They are also a feed ingredient for livestock and pet animals.

3. As natural food colorant and flavorant**:** Safflower petals are used as a natural colorant and flavorant in dishes like salads, soups, and stews. Petals can be candied or dried and ground into a powder for use as a food colorant or flavoring agent. Safflower petal water-extract can be used to make tea and is thought to help regulate blood glucose levels.

Conclusion

Safflower (*Carthamus tinctorius*) exemplifies a remarkable journey from ancient traditions to modern health applications. Historically, it was cultivated for its vibrant petals used in dyes and its seeds valued in traditional medicine for treating ailments like menstrual disorders and joint pain. In contemporary times, safflower oil has garnered attention for its health benefits. Rich in unsaturated fatty acids, it aids in lowering cholesterol, potentially reducing heart disease risk. Its anti-inflammatory properties may also support skin health and combat oxidative stress. Beyond health, safflower's versatility extends to culinary uses, where its oil serves as a cooking medium, and its petals are used as a saffron substitute. Industrially, safflower oil contributes to the production of paints and varnishes due to its quick-drying properties. In summary, safflower's enduring relevance across various domains underscores its status as a versatile herb, bridging ancient practices with modern innovations.

ROLE OF NUTRITION IN POULTRY PRODUCTION

A. Ameeta Devi [1*], Y. Prabhabati Devi[2] and Khumlo Levish[1]
[1]ICAR-Krishi Vigyan Kendra, Chandel, ICAR-RC for NEH Region Manipur Centre
[2]Krishi Vigyan Kendra, Imphal East, CAU, Imphal Manipur

Introduction

Nutrition plays a vital role in the growth, health, and productivity of poultry birds, impacting every aspect of their development and production performance. Poultry farming, a significant component of livestock agriculture, relies heavily on balanced and proper feeding practices to ensure optimal production of meat and eggs. A well-formulated diet not only ensures the health and well-being of birds but also directly influences their reproductive success, immune function, and resistance to diseases.

Advantages of poultry farming

- There are ample of jobs in this field
- Rearing of poultry is compratively easier than other livestock
- By supplying of meat, eggs, manure, etc
- They are suited in vast range housing system
- Poultry plays an important role in Rural economy

Important Economic Traits of Poultry Birds are as Egg production, Egg weight, Egg quality, Body size, Conformation, Growth, Feed efficiency, Fertility and Hatchability, overall performance.

Principle of poultry feeding

- Livestock and Poultry feeding is one of the important branches of Animal science, since feed cost alone accounts for 60-65 percent of the total farm expense. It is in the interest of every man to be able to get as much meat or as many eggs for every rupee that he spends on the feed as possible.
- The problems involved in the feeding in recent times are multifarious because of modern farming conditions such as (i) increased cost of feed, (ii) confinement rearing, (iii) Inclusive of agro-industrial bye-product, (iv) increase in flock size and high flock density.
- Being single stomach animal, the needs of poultry are very precise
- More concentrated ration is required as birds have no teeth.
- They have higher metabolic rate and hence need more specific ration.
- Poultry must get all essential nutrients present in balanced form.

- They have no sweat gland hence they are quite sensitive to environmental effects. Since birds feed collectively rather single therefore feed quality is more concerned.
- They cannot digest crude fiber and fat more than 6 – 7 %
- Unlike ruminant birds required essential vitamin-B complex, Vit-K. Clean and fresh water be made available at all times.
- The feed compounded must be palatable and free from fungal infestation. Optimum energy and protein ration must be maintained for the purpose.

Feeding Scedule

- Since feed alone accounts for 70% of total expenditure. So, it is imperative to minimize the cost on feed by incorporating locally available, low-cost feed ingredients like household residue.
- Household waste, crop by-production, broken grains may be offered.
- Broken rice, rice bran fodder, cabbage cut, banana tree in small quantity, tender grasses, insects, snails.

During egg laying period limestone or shell grid may be given to meet extra calcium.

Voluntary intake of birds depends on the following patterns- 1. Size of Bird, 2. Energy content of diet, 3. Physical contents of diet, 4. Physical form of diet, 5. Nutritional adequacy of diet, 6. Physiological adequacy of diet, and 7. Environmental temperature.

Energy Requirements for growth: Generally, the bird requires around 2.8 Mcal, ME/Kg i.e., DE=- Gross Feed – Energy lost from faeces ME=DE – Energy lost in urination

Since, birds excrete urine & faeces from same orifice they need metabolisable energy

While computing ration for poultry birds the following points should be considerd

- Unlike ruminants, where microorganism synthesize a sizeable portion of essential amino acids, vitamin B complex, Vitamin K in the stomach, the poultry completely depend upon the dietary source for all such nutrients.
- Poultry birds are fed collectively rather than individually.
- Due to higher rate of metabolism poultry require a more exact ration.

Nutrient requirements of poultry birds

The term nutrient means any single class of food, or group of like feeds, that aids in the support of life and makes it possible for birds to produce meat or eggs. They are classified according to physical, chemical and biological into following groups: More than 40 nutrients are required by the poultry. They can be classes according to their chemical nature and unction as they performed as:

- Water
- Protein
- Carbohydrates
- Fats and oil
- Minerals
- Vitamins

Feed additives (not a nutrient but added to enhance the quality of the nutrients)

Water

The internal environment of an animal is basically a water medium in which transport of nutrient occurs, metabolic reactions take place, and from which wastes can be eliminated, water makes up 85% of the body of days old chicks gradually decreases as chickens grow older, reaching a level of about 55% in mature chickens at 42 weeks of egg. The water content of whole egg is about 65%.

Ordinarily, chickens consume about 2-2.5 gms of water for each gram of feed consumed during the starting and growing period and form 1.5-2 gms of water per gms of feed as laying hens. Since an average poultry ration contains no more than 10 % water, a good supply of clean drinking water is essential for poultry and egg productions

Protein

In poultry, the products produced consist mainly of protein. On a dry weight basis the carcass of an 8 weeks old broiler is more than 65% protein and the egg contents are about 50 % protein. Typical broiler will contain from 22 to 24 % protein are really the essential nutrients rather than the protein molecule itself. The amino acid need of the growing chickens and layering hens are met in practice by protein of plant and animal

ISSN : 2279-0454

sources. Generally, it is necessary to choose more than one source of dietary protein, (i.e., animal and vegetable sources) to meet the amino acid requirement of the chicken. Of the essential amino acids, lysine, methionine, arginine, glycine, and tryptophan are referred as critical amino acids, since these are usually deficient in ordinary practical poultry ration .This is because cereals grains are usually low in critical amino acids which make up a large proportion of a usually poultry ration .It is thus a must to include a good proportion of animal protein of all critical amino acids.

Carbohydrate

The main function of carbohydrate in the diet is to provide energy to the animal. The polysaccharides of major importance are starch, cellulose, pentosans and starch other complex carbohydrates. Although cellulose and starch are composed of glucose units, chicken possess enzymes that can hydrolyse only starch. Cellulose, therefore, is completely indigestible. Cereal grains and their bye –products are excellent sources of starch and thus constitute a bulk of poultry ration.

Fats

Fats make up over 40% of the dry egg and about 17 % of the dry weight of a boiler. Although fats supply concentrated form of energy (2.25 times more energy than carbohydrate and protein) their inclusion as true fats or oils in the ration is seldom practised because of high cost and the risk of rancidity which develops on prolong exposure to air, heat, sunlight etc. Most feed ingredients (maize, barley, safflower, wheat, rice bran etc.) contain 2-5 % fat and that is enough for the inclusion of one essential fatty acid.

Linoleic acid which must be present in the diet of the young growing chicks or they will grow poorly, have an accumulation of liver fat and be more susceptible for respiratory infection. Layering hens with diets deficient in linoleic acid will lay very small eggs that will not hatch well

Minerals

The body of the chicken and the egg excluding shell contain nearly 4 and 1 % mineral matter respectively. The elements known to be required in the diet of poultry are calcium, phosphorus, sodium, potassium, magnesium, copper, molybdenum, zinc and selenium. The importance of each element may be learnt from any textbook of animal nutrition. Usually, the grains and vegetables protein ingredients are relatively poor in mineral contents when compared with those of animal protein feed stuff.

Vitamins

Vitamins most commonly function as co enzymes and regulators of metabolism. The 13 vitamins required by poultry have been summarised in tabular form. Apart from natural resources, commercial vitamin mixture suitable for poultry is also available. Diet continuously deficient in any one of the required vitamins will seriously tell initially upon the egg production and then the life of the chickens. Generally, the birds under free-range conditions can meet their protein requirement through scavenging, but the possibility of energy deficiency is common. Therefore, feeding the birds with deferent household cereals grains/ their by- products is necessary to sustain the production under free range conditions. Generally, up to 20 to 50 g per bird per day is required to sustain prescribed production. The need for additional feed supplementation depends on the free area available in the backyard, intensity of vegetation and availability of waste grains, insects, white ants, grass seeds.

The nature of supplemental feed during brooding and subsequent rearing mostly depends on the purpose of rearing. If the bird is reared for meat purpose, feeding the birds with commercial broiler starter feed is suggested. If the purpose of rearing is for egg production feeding commercial layer grower feed up to 6 weeks, followed by either complete feed or cereals (like wheat, maize, broken rice, with equal parts of rice polish or rice bran) depending on the foraging conditions available are suggested.

- For broiler bird (i) Starter mash. (ii) Broiler finisher.
- For layer bird (i) Starter mash 0-8 week. (ii) Grower rations 9-18 weeks, (iii) Layer mash 18 week and above.

Calcium: In laying hen deficiency of Calcium results in improper development of the egg shell causes soft bone, beak, curved legs and low egg production.

Sources of calcium – Requirement 1.8%/kg feed Green Leafy Vegetable, Animal byproduct – Bone meal, fish meal meat meal contain 50-55% of protein.

Potassium – In poultry associated with retarded growth, weakness, tetany, loss of production. If high intake causes interfere with absorption of magnesium.

Zinc: Retarded growth, frizzled feather, parakeratosis and bone abnormality.

Manganese: Causes perosis or slipped tendon and malnutriton of the leg bones. Reduces hatchability and head retraction. Requirement 55mg/kg ration.

Sources- Maize, oat, wheat, green fodder and bran.

Feed ingredients

Conventional poultry rations usually include many cereals like maize, rice, wheat, oat, barley and few cereal biproducts such as wheat bran or rice polish, animal and vegetable source like fish meal and soyabean or groundnut, etc. according to their availability. The whole ration is fortified with adequate quantities of minerals and vitamins either in chemically pure form or through ingredients rich in their nutrients. It is used as a source of energy and low in protein specially lysine and sulphur containing

Conventional poultry feed

Maize: It is highly digestible and contains very little fiber amino acids. The yellow varieties are good source of vitamin A.

Wheat: It can be used for replacing maize.

Wheat bran: It is quite laxative and bulky and high content of manganese ang phosphorous.

Rice: Broken grains of rice can be used to replace maize.

Rice polish: This is very good substitute for cereal grains and can be used up to 50% 0f the ration

Sorghum: It is highly palatable and can replace maize and also high protein content.

Groundnut cake: It is highly palatable and 40% protein content and widely used in poultry diet.

Fish meal: It is high protein value and up to 55% of protein and having animal protein factor and available essential amino acids.

Lime stone: Lime is a source of calcium. Tapioca leave: high source of energy.

Mustard cake: It is high quality protein feed of birds but due to contains of glycosides

Feeding Requirement for Poultry Birds

- 0-1Week: 30 gm /bird/day.
- 1-2 weeks: 45 gm /bird/day.
- 2-3 weeks: 60 gm /bird/day.
- 4-6 weeks: 100 gm/bird/day.
- Laying birds: 100-110 gm/bird/day.

Feeding constitute the fundamental and major management concern in poultry production since major expenditure is 60-70% in poultry raising in feed cost efficiency in feeding is one of the key factors for successful poultry production.

Conclusion

Proper nutrition is a fundamental pillar of successful poultry farming. It not only ensures optimal growth, egg production, and feed efficiency but also strengthens the immune system and enhances overall flock health. By providing a balanced diet tailored to the birds' specific life stages and production goals, farmers can significantly improve productivity, profitability, and sustainability in poultry operations. Proper feeding is very much essential as inadequate or imbalanced nutrition can lead to poor performance, disease susceptibility, and economic losses, highlighting the importance of careful feed formulation and management for long-term success in poultry farming.

ISSN : 2279-0454

CUCURBITS: AN IMPORTANT CROP TO BEAT THE SUMMER HEAT

Ps. Mariam Anal, Sagolsem Daina Devi, Ichantombi Chingkheimayum and Meikambam Jusma Devi
College of Agriculture, CAU (Imphal), Manipur-795004

Introduction

Cucurbits are a large group of vegetables which belongs to the family Cucurbitaceae. They are mostly vines bearing tendrils and are grown in tropical and sub-tropical regions (Robinson and Decker-Walters, 1999). The family Cucurbitaceae consists of 118 genera and 825 species (Jeffrey 1990). Liberty Hyde Baile coined the term 'cucurbits'. India has a rich diversity of cucurbits and is thought to be the primary and secondary centres of origin of many of the gourds and melons (Choudhary, 1996). Gourds, melons, squashes and cucumber are the main groups of crops under the family Cucurbitaceae. Cucumber, water melon, musk melon and long melon act as a coolant providing relief from summer heat.

Table 1. Some of the commonly grown cucurbits

Name	Scientific Name	Origin	Chromosome No.
Ash gourd	*Benincasa hispida*	South East Asia	24
Bottle gourd	*Lagenaria siceraria*	Ethiopia	22
Bitter gourd	*Momordica charantia*	Indo-Burma	22
Sponge gourd	*Luffa cylindrica*	India	26
Ivy gourd	*Coccinia cordifolia (syn. C. indica)*	India	24
Pointed gourd	*Trichosanthes dioica*	India	22
Cucumber	*Cucumis sativus*	India	14
Pumpkin	*Cucurbita moschata*	Peru and Mexico	40
Watermelon	*Citrullus lanatus*	Tropical Africa	22
Muskmelon	*Cucumis melo*	Tropical Africa	24
Summer squash	*Cucurbita pepo*	Peru and Mexico	40
Winter squash	*Cucurbita maxima*	Peru and Mexico	40

(Source: (Pandey and Kumar, 2011)

Chayote or Chow-chow and fig-leaf gourd are grown in cooler region like Ukhrul in Manipur, India. Edible part of Chayote is fruit, tender shoot and under ground tuber. Tender young fruit and tender shoots are consumed after cooking whereas matured seeds of fig-leaf gourd is roasted and eaten as delicious snack.

Most of the cucurbits are annuals, and are propagated through seed. However, some of the cucurbits like pointed gourd, Ivy gourd and chow-chow being perennials, are propagated vegetatively. Cucurbits fruits come in various shapes, sizes and colour. The majority of cucurbits species at some stage in their development possess the bitter principle which is known as cucurbitacin. In crops like cucumber, bottle gourd and long melon, bitterness is more noticeable.

Uses of cucurbits

The cucurbits family has some economic significance. The fruits can be consumed in various forms. Watermelon and muskmelon fruits are consumed fresh as a dessert and cucumber, summer squash and long melon are used in salads. Bottle gourd, bitter gourd, sponge gourd, ridge gourd, summer squash, squash melon, pumpkin etc. can be cooked. Processed into value added products like pickles from pickling cucumber, pointed gourd. Jam and pie are prepared from pumpkin and sweet candied, commonly known as petha is prepared from matured ash gourd fruit.

Cucurbit species such as bottle gourd and summer squash have a tough rind and are utilized for containers, cutlery, musical instruments, ornaments and many more purpose. Dry fruits of sponge gourd can be used as scrubbing pads. The vibrant ornamental gourds which are available in different shapes and sizes can be used as decoration pieces.

Nutritive value

Cucurbits may be very beneficial to diet-related health. They can provide substantial dietary sources of minerals and vitamins. Cucurbits are typically valued for their flavourful fruits, which can have an aromatic, bitter, or sweet taste. The seeds are a good source of protein and vegetable oil.

Table 2. Nutrient components of the fruits of some of the cultivated cucurbits (per 100g of edible portion) (Purseglove, 1968)

Nutrient components	Ash gourd	Water melon	Cucumber	Musk melon	Winter squash	Pump-kin	Summer squash	Bottle gourd	Bitter gourd
Water (g)	92.5	92	96.3	92.7	92.6	94	92	96.1	92.4
Protein (g)	0.4	1.0	0.4	0.6	1.4	1.0	1.5	0.2	1.6
Fat (g)	0.1	-	0.1	0.2	0.1	0.1	0.1	1.0	0.2
Minerals (g)	0.3	-	0.3	0.3	0.6	0.6	0.6	0.5	0.8
Fibre (g)	0.8	-	0.4	0.5	0.7	0.7	0.7	0.6	0.8
Carbohydrate (g)	1.9	6.5	2.5	5.9	4.6	4.6	4.8	2.5	4.2
Energy(calori)	10	35	13	125	13	21	25	12	25
Ca (mg)	30	7.0	10	0.17	10	23	15	120	20
Mg (mg)	-	-	11	-	14	14	15	5	17
Na (mg)	-	-	10.2	-	5.6	5.6	5.9	1.8	17.8
K (mg)	-	-	50	-	139	139	150	87	152
S (mg)	-	-	17	-	16	16	18	10	15
Fe (mg)	0.8	-	1.5	0.04	0.7	0.3	0.8	0.7	1.3
Vit A (I.U.)	20	599	40	190	1840	2000	1700	60	210
Vit C (mg)	1.0	6.0	7.0	35	2.0	15	20	6	88

The fruits of *Benincasa hispida*, *Citrullus lanatus*, *Cucumis sativus*, *Cucumis melo*, *Cucurbita maxima*, *Cucurbita moschata*, *Cucurbita pepo*, *Lagenaria siceraria and Momordica charantia* are rich in minerals, fiber, carbohydrates, iron, sodium, potassium, calcium etc. in addition to water content. It also contain good amount of vitamin A and vitamin C (Table 2). Being low in fat, they can be included in diets for maintaining body weight.

Medicinal and health benefits:

Health benefits of some of the cucurbits are as follows (Rahman *et al.*, 2008):

Water Melon: Fruit has several uses, including cooling, strengthening, aphrodisiac, astringent to the bowels, indigestible, expectorant, diuretic, stomachic, blood purifying, quelling thirst, curing biliousness, and treating itching, scabies, and sore eyes. The seeds have brain-boosting properties.

Cucumber: Its fruits are also beneficial for digestion and aid in the relief of constipation in humans. Fruits are a popular cooling food in the summer. Seeds have anthelmintic, diuretic, cooling, and tonic properties. Leaves are applied to sore throats along with cumin seeds.

Bitter Gourd: The fruits have cooling, carminative, stomachic, and tonic properties. Fruits have significant benefits for people with diabetes. The fruits are also used to treat rheumatism, gout, liver and spleen diseases, and fever. The leaves and fruits have anthelmintic properties that help with jaundice, leprosy, and piles.

Pumpkin: Due to their high vitamin A content, fruits are beneficial to eyesight. The fruit relieves thirst and is

ISSN : 2279-0454

tonic and diuretic. The seeds are diuretic, tonic, and anthelmintic. Fruit pulp is frequently applied to boils and inflammations.

Ash gourd: Fruits' biochemical components have benefits for human health. Fruit has specific benefits for internal organ haemorrhages and is tonic, nutritive, diuretic, and antiperiodic. Additionally, it helps with epilepsy, other nerve diseases, and mental health issues. It is also helpful as an aphrodisiac, for colic pain, heart disease, TB, and constipation.

Summer squash: The fruits are laxative, cooling, and beneficial to the eyes, throat, and teeth. They are also astringent to the bowels. The leaves can be applied topically to burns and are edible, haemostatic, analgesic, and biliousness-removing. The seeds are diuretic, tonic, fattening, and beneficial for the kidneys and brains. They also relieve fever, bronchitis, and sore chests.

Bottle Gourd: Fruit's white pulp has antibilious, purgative, emetic, cooling, and diuretic properties. The seeds' oil has a cooling effect and is applied to headache relief. Besides being diuretic, seeds are nutritive. Infusion of sugar-infused leaf decoction used for jaundice. To treat cholera, fruit is used.

Musk Melon: Ripe fruits have great therapeutic value for kidney disease in humans. The seeds are cooling, diuretic, nourishing, and helpful for prostate gland enlargement. The pulp helps both acute and chronic eczema because it is a diuretic. The ripe fruit relieves biliousness, calms fatigue, and is cooling, flattening, tonic, laxative, and aphrodisiac.

Long melon: It has light green colour fruits having smooth skin and white flesh. Mainly eaten raw as a salad with salt and pepper. Fruit contains cooling effect therefore it is mainly eaten in summer season.

Conclusion

Cucurbits are an important warm season crops to beat the summer heat. They offer different uses in many culinary purpose and others. Cucurbits like watermelon, muskmelon, longmelon, snap melon, etc. are generally consumed raw as salad to quench the thirst which gives satisfaction and filled. Cucurbits fruits have different characteristics in terms of shape, size, colour and taste. The fruits have a good source of nutrients and provide significant health benefits.

SPREADING WINGS: HOW VANARAJA CHICKENS ARE TRANSFORMING BACKYARD POULTRY IN SOUTH GARO HILLS, MEGHALAYA

Rupam Bhattacharjya, Athokpam Haribhushan, Karam Amarjit Singh, Tanya R Marak, Monika Thongam, Rike Chalchak Sangma, Basu Langpoklakpam and Titus Dalang K Momin

Krishi Vigyan Kendra, South Garo Hills, Chokpot, Meghalaya, CAU, Imphal

Executive Summary

A quiet revolution is taking place in the hilly terrains of Meghalaya's South Garo Hills district. At the heart of it is a robust, dual-purpose poultry breed – Vanaraja - that's winning the trust of rural farmers and reshaping the economics of backyard poultry. A recent initiative by Krishi Vigyan Kendra (KVK) South Garo Hills has not only introduced the breed to remote villages but has also equipped farmers with the skills and tools to build sustainable poultry livelihoods. The results? Bigger birds, better eggs, and a brighter future.

A Need for Change

Backyard poultry farming has long been a vital livelihood in South Garo Hills. Yet, productivity from traditional Desi birds has remained low, often making poultry an unreliable source of income. Addressing this, KVK South Garo Hills launched a focused intervention in the villages of Dagalgopgre, Bibragre, and Dobogre with the introduction of the Vanaraja breed, known for its resilience, size, and productivity.

Building Awareness and Reducing Costs

The initiative wasn't just about handing out chicks. The team rolled out a two-pronged strategy:

1. **Farmer Awareness & Training:** Villagers were trained in best practices for Vanaraja management, feeding, and health care.
2. **Sustainable Inputs:** Emphasis was laid on self-sufficiency - encouraging farmers to hatch eggs and prepare feed locally, reducing their dependency on external suppliers.

This model aimed to empower farmers with knowledge while minimizing recurring costs.

Bigger Birds, Bigger Profits

How does Vanaraja compare to the traditional Desi chicken? The numbers speak for themselves:

Parameters	Vanaraja	Desi
Body Weight at 52 weeks	3,250 g	1,980 g
Eggs by 52 weeks	86	46
Egg Weight (at 52 weeks)	54 g	36 g
Age at First Egg	188 days	205 days
Mortality (0–5 weeks)	13%	9%

The economic advantage is significant. With a modest investment of Rs. 3,500 for 20 birds, farmers were able to generate a net return of Rs. 8,500, reflecting a benefit-cost ratio of 2.4 - a compelling case for wider adoption.

Local Voices, Real Impact

For farmers like Wilman Ch Momin, the change has been tangible *"It looks like our local birds, but its size is very impressive, and it will definitely fetch a good return,"* he shares with a smile. Such testimonies are becoming common as more farmer's express interest. Within the pilot villages, 30 farmers have already adopted the Vanaraja breed, and interest is growing rapidly across neighbouring communities.

Challenges Along the Way

Despite the positive response, the journey has not been without hurdles. Two key issues emerged:

- **Chick Availability**: Supply chains for Vanaraja chicks remain inconsistent.
- **Feed Access:** Starter feed, critical in early growth stages, is often hard to procure regularly.

To address these, the KVK team has made targeted recommendations:

1. Diversification: Introducing breeds like Rainbow Rooster and Giriraja to provide alternatives.
2. Integrated Farming Systems (IFS): Promoting models that combine poultry with fish or crop farming to optimize returns.

ISSN : 2279-0454

A Model Worth Scaling

The "Popularization of Vanaraja" initiative is more than a breed introduction - it's a scalable model of rural upliftment. With measurable productivity gains, better income potential, and increasing farmer participation, the program lays a foundation for resilient, low-cost poultry systems in the region. With continued support, training, and diversification, this initiative could very well mark the beginning of a backyard poultry revolution in Meghalaya.

CULTIVATION AND CONSUMPTION OF MILLETS FOR HOLISTIC HEALTH BENEFITS

Nungleppam Monica[1], Joy Kumar Dey[1*], Th. Robindro Singh[2], Dipak Nath[2] and Shatabhisa Sarkar[1]

[1]Krishi Vigyan Kendra-Sepahijala, Central Agricultural University (I), Latiacherra, Tripura

[2]Directorate of Extension Education, Central Agricultural University (I), Lamphelpat, Imphal West, Manipur

Introduction

Millet is a type of cereal grain, similar to rice and wheat, but it offers several unique benefits that these common staples lack. Due to its high nutritional value, millet is often referred to as a "Nutri-Cereal." Although once widely consumed in India, millet lost popularity during the Green Revolution, which primarily promoted the cultivation of wheat and rice. Today, millet is recognized as a sustainable crop that not only supports human health but also benefits the environment, making it a strong alternative to major cereals like wheat and rice. To revive its importance, India declared 2018 as the National Year of Millets. Building on this momentum, the United Nations, following a proposal by India, declared 2023 as the International Year of Millets to raise global awareness about this smart crop and its role in ensuring a sustainable and healthy future. Millet cultivation is widespread across various parts of India, with major production taking place in states like Haryana, Uttar Pradesh, Chhattisgarh, Gujarat, Rajasthan, Madhya Pradesh, Maharashtra, Andhra Pradesh, Karnataka, Tamil Nadu, and Telangana (Banerjee & Mondal, 2023). In the northeastern region, millets are also grown in states such as Nagaland, Meghalaya, and Tripura, with limited cultivation seen in parts of Manipur and Mizoram. In Tripura, Foxtail is mainly cultivated in upland regions using Jhum farming, a traditional shifting cultivation practice commonly followed by the indigenous tribes of the area. They have traditionally practiced mixed cropping systems, where Foxtail millet is often cultivated in an intercropping system alongside crops such as sesame, rice, maize, and others. To promote millet cultivation, the state has introduced cluster demonstrations under the 'National Food Security Mission – Nutri Cereals,' providing financial support to farmers. This initiative has contributed to a steady increase in both the area and production of millets in Tripura. Notably, during the Kharif season, the area under foxtail millet cultivation expanded from 352 hectares in 2016–17 to 1,119 hectares in 2020–21, accompanied by a significant rise in output (Parisa, 2024).

Types of Millets

Millets are broadly classified into two categories based on grain size: major millets and minor millets. Major millets include sorghum (*jowar* in Hindi), pearl millet (*bajra*), and finger millet (*ragi*). Minor millets comprise foxtail millet (*kakum*), barnyard millet (*sanwa*), kodo millet (*kodo*), proso millet (*chena*), and little millet (*kutki*). In addition to these, there is a third group known as pseudo millets—these are not true millets but share similar nutritional and culinary properties. Examples of pseudo millets include amaranth (*rajgira*) and buckwheat (*kuttu*) (Bhardwaj et al., 2023).

Nutritional Composition and health benefits

Millets provide numerous health advantages, including lowering blood pressure, reducing the risk of heart disease and cancer, improving cholesterol levels, and helping to manage obesity and digestive issues. Additional health benefits of millet include slowing down gastric emptying and providing dietary fiber that supports digestive health. Millet is also an alkaline-forming food, which, when combined with digestive enzymes, contributes to overall well-being. Its gentle alkaline properties help maintain the body's pH

balance, an important factor in disease prevention and maintaining optimal health. Millets are rich in magnesium, a mineral known to help alleviate migraines and reduce the risk of heart attacks. They also contain beneficial phytochemicals, such as phytic acid, which is recognized for its cholesterol-lowering properties. Additionally, studies suggest that finger millet may help prevent cardiovascular diseases by lowering plasma triglyceride levels in hyperlipidemic rats. Celiac disease is an immune-related intestinal disorder caused by the consumption of gluten in individuals with genetic susceptibility. Since millets are naturally gluten-free, they serve as an ideal alternative for those with celiac disease or gluten sensitivity, who may experience adverse reactions to the gluten found in wheat and other common cereals. Additionally, millets have a low glycemic index, making them a suitable and beneficial food choice for individuals with diabetes, as they help regulate blood sugar levels more effectively (Sarita & Singh, 2016). They have rich nutritional profile and are packed with essential micronutrients, proteins, dietary fiber, phenolic compounds, and beneficial phytochemicals. Typically, millets contain 7–12% protein, 2–5% fat, 65–75% carbohydrates, and 15–20% dietary fiber (Parisa, 2024). Millets stand apart from other cereals due to their rich content of calcium, dietary fiber, polyphenols, and protein. Finger millet contain the highest calcium in the range of 344mg/100g even higher than that of milk, which is around 120 mg/100 ml. Finger millet (Ragi) contains the highest amount of calcium among cereals—approximately ten times more than that found in rice or wheat (Michaelraj & Shanmugam, 2013). Millets are rich sources of vitamin B, magnesium, and antioxidants. They are packed with both macro- and micronutrients, offering higher levels of minerals and essential amino acids compared to common cereals like wheat and rice.

Among various millets, finger millet contains the highest carbohydrate content at 72.05 g per 100 g, followed by proso millet (70.4 g), barnyard millet (68.8 g), pearl millet (67.0 g), kodo millet (66.6 g), and little millet (65.55 g). Foxtail millet ranks lowest in carbohydrate content. When it comes to protein, proso millet leads with about 12.5 g per 100 g, followed by pearl millet (11.8 g), foxtail millet (11.2 g), barnyard millet (10.5 g), kodo millet (9.8 g), little millet (7.3 g), and finger millet. Proso millet also stands out for its high dietary fiber content, approximately 14.2 g per 100 g.

Millets are abundant in essential minerals such as phosphorus, calcium, iron, zinc, magnesium, potassium, sodium, manganese, and copper. They also supply important vitamins, including thiamine (0.55 mg/100 g in proso millet), riboflavin (2 mg/100 g in kodo millet), and niacin (5.11 mg/100 g in proso millet). In addition to nutrients, millets contain phytochemicals—bioactive compounds with health-promoting effects. Kodo millet has a notably high level of total phenols and flavonoids (19.7 mg gallic acid equivalent/g and 11.1 mg catechin equivalent/g, respectively), while pearl millet contains the highest amount of phytosterols at 58 mg per 100 g (Bhatt *et al.*, 2022).

Benefits of Millet Cultivation for Farmers and the Environment

Millets play a crucial role for small-scale farmers in developing countries, serving as a key source of both nutrition and income. Cultivating millets offers a sustainable and dependable food supply, while also delivering notable economic and environmental advantages. From an economic perspective, millet farming is highly cost-efficient. It demands less water than many other crops and has a natural resistance to pests, reducing the need for expensive pesticides and agricultural inputs. Certain millets, such as pearl millet and proso millet, require as little as 20 cm of rainfall, which is significantly lower than rice, which needs an average of 120–140 cm (IRRI, 2015). As a result, millets are considered non-waterlogging cereal crops and are well-suited for cultivation in areas without standing water. Millets are also adaptable to diverse climates and soil conditions, making them suitable for regions where other crops may struggle to grow. These crops can be cultivated in shallow, low-fertility soils with a pH range spanning from acidic (4.5) to alkaline (8.0) conditions. Millets serve as an excellent substitute for wheat, particularly in acidic soils. Unlike rice, which is highly sensitive to saline conditions and performs poorly in soils with salinity above 3 dS/m, millets such as pearl millet and finger millet can thrive in soils with salinity levels as high as 11–12 dS/m. Their culinary versatility further boosts their economic potential by allowing for use in a wide range of food products.

Environmentally, millets offer several benefits. Their drought tolerance enables them to thrive in arid regions, ensuring food security even in areas with limited water resources. Being a low-input crop, millets require minimal fertilizers and chemicals, thereby lowering the environmental footprint of farming. Additionally, some millet varieties contribute to soil health by fixing nitrogen, which helps restore essential nutrients to the soil (Pathak, 2023). Moreover, millets are classified as C4 cereals, which are known for their

ISSN : 2279-0454

efficient photosynthesis process—absorbing more carbon dioxide from the atmosphere and converting it into oxygen. Another benefits of cultivating millets for farmer is most millets mature within 60 to 90 days after sowing, making them efficient in terms of water usage. Among them, barnyard millet has the shortest maturation period, ranging from 45 to 70 days—about half the time required for rice, which takes 120 to 140 days to mature. This makes barnyard millet a fast-growing, early-maturing millet crop (Kathare, 2019).

Processing of millets

Food processing methods are employed to improve the nutritional value, increase the digestibility and bioavailability of nutrients, while also reducing anti-nutrients. Millets are also associated with certain antinutrients such as phytates that can be reduced by common techniques, which include decortication, milling, soaking, cooking, germination, fermentation, malting, popping, and others. Various ethnic communities in the North Eastern region prepare a range of value-added products made from millet, which includes Bangui, a traditional steamed dish from Tripura, uniquely prepared by wrapping it in broad Lairu / banana leaves and Awan Sokrang is a steamed dish made with foxtail millet and sticky rice, typically prepared during festivals (Parisa, 2024). Therefore, millets hold a significant cultural role among the tribal communities in the region, from being used in offerings during harvest festivals to being a key ingredient in traditional dishes and fermented beverages. Hence, millets can be transformed into a wide range of value-added products and included in our diet to enhance nutritional value.

Conclusion and Recommendation

Millets, once a staple food, have regained recognition due to their high nutritional value, environmental sustainability, and economic benefits, making them a promising alternative to major cereals like wheat and rice. With their rich content of essential nutrients, including calcium, fiber, vitamins, and antioxidants, millets offer several health benefits such as improving digestion, managing blood sugar levels, and preventing heart disease. Additionally, millet farming provides a cost-effective, low-water alternative for farmers, contributing to food security while supporting environmental sustainability. Millets can be processed for the creation of various value-added products that enhance dietary nutrition, making millets an integral part of both cultural traditions and modern food systems. With increasing support for millet cultivation, particularly through initiatives like the International Year of Millets 2023, this "Nutri-Cereal" is poised to play a crucial role in promoting sustainable agriculture and improving global health outcomes.

To further promote the cultivation and consumption of millets, Governments should provide greater policy support and financial incentives to promote millet farming, especially in regions facing water shortages or poor soil quality. This could involve providing subsidies for seeds, equipment, and post-harvest processing technologies, as well as financial rewards for farmers adopting millet cultivation. Public awareness campaigns should be launched to educate consumers and farmers about the health benefits and environmental advantages of millets. Increased investment in research and development is essential to enhance millet varieties that are more resilient to climate change, pests, and diseases. Additionally, research should focus on developing processing techniques that add value to millets, create a variety of products, and extend their shelf life.

Figure: Cultivation of Finger Millets at KVK Sepahijala, Latiacherra

PROGRESS AND PROSPECTS OF SESAMUM CULTIVATION IN TRIPURA

Joy Kumar Dey[1*], Nungleppam Monica[1], Th. Robindro Singh[2], T.M. Chanu[2] and Shatabhisa Sarkar[1]

[1]Krishi Vigyan Kendra-Sepahijala, Central Agricultural University (I), Latiacherra, Tripura

[2] Directorate of Extension Education, Central Agricultural University (I), Lamphelpat, Imphal West, Manipur

Introduction

Sesamum, commonly known as sesame or til, is one of the oldest and most significant oilseed crops in the world. It is primarily cultivated for its seeds, which are rich in oil, providing high-quality vegetable oil with a distinct nutty flavor. Sesame is known for its resilience to drought and its ability to grow in a variety of climates and soil types, making it a valuable crop for small-scale farmers in many regions, especially in Asia, Africa, and parts of the Middle East. Sesame is often regarded as the leading oilseed crop due to its exceptionally high oil content, ranging between 46% and 52%, and a protein content of about 18% to 20%. It is popularly known as the "Queen of Oilseed Crops" because of the superior quality of its oil (Awomi *et al.*, 2024).

In Tripura, sesame cultivation holds significant cultural and economic value. The state's agro-climatic conditions are conducive to sesame farming, particularly in sandy-loam soils with adequate moisture. Sesame is grown during multiple seasons, including Kharif, Rabi, and summer, and is integral to crop rotation and intercropping systems. The Tripura government, through initiatives like the National Mission on Oilseeds and Oil Palm (NMOOP), has been promoting sesame cultivation to enhance oilseed production and ensure nutritional security. Additionally, the residue from oil extraction, known as oilseed cake, serves as valuable cattle feed, contributing to the state's livestock sector. Culinarily, sesame is deeply embedded in Tripura's traditions. Black sesame seeds are commonly used to prepare 'Til Pitha' and 'Tiler Naru' (sesame seed balls), especially during pujas and festivals, reflecting its cultural significance.

Nationally, India is among the top producers of sesame, with an area of approximately 1.98 m ha under cultivation, yielding about 0.81 m t. The average productivity stands at 430.5 kg/ha. However, this is below the global average of 512 kg/ha (Bhaumik *et al.*, 2023). In Tripura, specific data on sesame cultivation is limited. However, studies indicate that certain sesame varieties in the region have shown promising yield potentials. For instance, a study conducted in West Tripura district evaluated different sesame varieties for their yield potentials, suggesting the crop's adaptability to the region's conditions. Varieties RT-54, Nirmala, JTS-8, JLT-408 and Rama were found to be conducive in the West Tripura district (Dey *et al.*, 2016). In 2023, Sesamum was cultivated on approximately 12,000 hectares in Tripura, yielding 8,000 metric tons at an average productivity of 667 kg/ha.

Current Status of Sesamum Cultivation in Tripura

Traditional sesame farming in Tripura often involves manual sowing and harvesting techniques, relying on indigenous knowledge and practices passed down through generations. These methods, while sustainable, may result in lower yields and higher labor intensity. In contrast, modern agricultural techniques incorporate mechanization, improved seed varieties, and advanced agronomic practices, leading to enhanced productivity and efficiency. The adoption of such modern methods can significantly benefit sesame cultivation in the region, provided there is adequate support and training for local farmers. Currently, sesame cultivation in Tripura is at a crossroads, balancing traditional practices with the potential for modernization. While the crop remains a staple in the state's agricultural landscape, challenges such as limited access to quality seeds, lack of mechanization, and vulnerability to climatic variations hinder optimal production. Addressing these issues through targeted interventions can revitalize sesame farming in the region. Traditional varieties such as 'Krishna Til' and 'Rama Til' are commonly cultivated in Tripura. 'Krishna Til' is characterized by its black seeds and is often used in traditional ceremonies, while 'Rama Til' has white seeds and is favored for its oil quality. Improved varieties like 'B-67' (also known as 'Tilottama') is gaining popularity due to their higher yield potential and better adaptability (Naik *et al.,* 2016). Sesamum is a versatile oilseed crop grown across various agro-ecological zones, and it can be cultivated both as a monocrop and in intercropping systems. The choice depends on regional climatic conditions, soil fertility, and farmer objectives (e.g., income, soil health, risk management). Intercropping is a sustainable strategy where sesamum is grown alongside with compatible crops. This system improves land use efficiency, enhances biodiversity, and supports soil health. Growing legumes alongside non-leguminous crops often benefits the latter, as legumes contribute nitrogen to the soil through biological

ISSN : 2279-0454

fixation. Intercropping sesame with pulse crops across different regions of the country has shown promising outcomes—enhancing both overall yield and soil fertility. Short-duration legumes such as green gram and black gram are especially suitable as intercrops with sesame under rainfed upland conditions (Sarma *et al.*, 2016). The Government of India, along with various state governments, has launched multiple schemes to support oilseed production, including Sesamum (sesame). These initiatives aim to improve productivity, ensure better income for farmers, and enhance self-sufficiency in edible oil production. One such major scheme is the National Food Security Mission–Oilseeds (NFSM-Oilseeds), which promotes improved varieties of Sesamum, provides training on best agronomic practices, and supports cluster demonstrations. Another flagship program, the Rashtriya Krishi Vikas Yojana (RKVY), offers subsidies for quality seeds, biofertilizers, farm equipment, and micro-irrigation systems to encourage Sesamum cultivation. For instance, under RKVY, Sesamum farmers receive financial assistance for seed procurement, fertilizers, and drip irrigation setups to improve crop productivity and sustainability. The government is playing a crucial role in making Sesamum a profitable and sustainable crop choice for small and marginal farmers.

Challenges Faced by Sesamum Farmers of Tripura

Sesame cultivation is highly sensitive to climatic conditions. Frequent droughts, especially during the flowering stage, can significantly reduce yields. Conversely, excessive rainfall and water logging adversely affect plant growth and seed quality. Studies have shown that both drought and flooding lead to stunted growth, reduced dry matter, and lower seed yields in sesame crops (Mensah *et al.*, 2006). Sesame crops are susceptible to various pests and diseases. The sesame leaf roller and capsule borer (*Antigastra catalaunalis*) are prevalent across sesame-growing regions and can cause significant damage by feeding on leaves and capsules. Phyllody disease, caused by phytoplasma and transmitted by leafhoppers, transforms floral parts into leafy structures, rendering the plant sterile. Wilt, caused by *Fusarium* species, leads to plant wilting and death, especially under high soil moisture conditions. Many sesame farmers lack access to high-quality seeds and essential agricultural inputs. This limitation hampers the adoption of improved varieties and modern farming practices, leading to suboptimal yields. Sesame is predominantly cultivated under rainfed conditions, making it heavily reliant on monsoon rains. The absence of adequate irrigation facilities means that any irregularity in rainfall patterns can severely impact crop productivity. Sesame farmers often face challenges in accessing markets, leading to exploitation by middlemen and exposure to volatile price fluctuations. Such market uncertainties discourage investment in sesame cultivation and affect farmers' incomes. Post-harvest losses in sesame can be substantial due to inadequate storage facilities, improper handling, and pest infestations. Studies indicate that storage losses alone can account for up to 91% of total post-harvest losses in sesame. Factors such as prolonged storage durations, inappropriate stacking, and poor storage conditions contribute to these losses (Gebregergis *et al.*, 2024).

Economic Analysis of Sesamum Farming in Tripura

Sesame farming involves various expenses, including land preparation, seeds, fertilizers, pesticides, labor, and irrigation. For instance, a study in India reported that the cost of cultivation for sesame under improved practices was Rs. 16,340 per hectare, compared to Rs. 12,760 under traditional farmer practices. Notably, sesame's low input requirements, especially minimal fertilizer usage, make it a cost-effective crop for smallholder farmers (Singh *et al.,* 2020). Yields and income from sesame farming can vary based on practices and regions. In India, improved cultivation techniques have demonstrated significant benefits. For example, front-line demonstrations in Andhra Pradesh showed that sesame-maize cropping systems yielded a net income of Rs. 50,329 per hectare with a benefit-cost ratio (BCR) of 4.35 (Kumar *et al.*, 2020). Comparative analyses indicate that sesame can be more profitable than certain other crops. In Haryana, India, sesame exhibited a BCR of 1.16, compared to 1.09 for bajra and 1.21 for cluster bean (Pawar *et al.*, 2023). Sesame cultivation plays a vital role in enhancing household income and livelihood security. In Ethiopia, sesame farming has been identified as a suitable crop for poverty alleviation among smallholders, offering high profits with minimal investment. Similarly, in Nigeria, sesame production contributes significantly to the livelihoods of farmers, providing both income and employment opportunities. Front-line demonstrations in Andhra Pradesh showcased the success of improved sesame cultivation practices, leading to higher yields and profitability. Farmers adopting improved sesame varieties like Binatil-3 experienced substantial increases in net returns and BCR, highlighting the economic viability of sesame farming. Smallholder farmers in Benishangul Gumuz achieved high profits from sesame cultivation without significant up-front investments, underscoring its potential for poverty alleviation (Singh *et al.*, 2020).

Post-Harvest Processing and Value Addition of Sesamum

Traditional sesame processing encompasses several manual steps such as sun-drying to reduce moisture content to about 10%, preventing mold and ensuring safe storage then the seeds are separated from pods through manual threshing, followed by winnowing to remove chaff. And in certain regions, dehulling involves soaking seeds in lukewarm water for 5–6 hours, sun drying, and manually milling using mortar and pestle. After that, oil is extracted using wooden or stone presses (ghani), where seeds are crushed manually or with animal assistance. Advancements have introduced mechanization to enhance efficiency and product quality. In modern processing different machines or equipments are used to increase the efficiency. For instance, mechanical threshers helps to expedite the separation of seeds from pods, reducing labor and time, mechanical screw presses extract 50% to 75% of oil content from seeds, offering higher efficiency compared to traditional methods. Post mechanical pressing, residual oil is extracted using solvents like hexane, maximizing yield. Modern facilities employ degumming, neutralization, bleaching, and deodorization to produce high-quality, edible sesame oil.

Sesame's versatility allows for a range of value-added products such as Sesame Oil, which is widely used in culinary applications, its production has seen significant growth due to health-conscious consumers, Sesame Seeds, which is used in baking and as toppings, they are also processed into snacks, Sesame Paste (Tahini), a staple in Middle Eastern cuisine, it is gaining popularity globally and Sesame-Based Snacks like sesame bars and crackers cater to health-focused markets.

Government Policies and Support Systems for Sesamum Cultivation

The Government of India has implemented several initiatives to bolster Sesamum (sesame) cultivation such as National Food Security Mission (NFSM). Under the NFSM-Oilseeds & Oil Palm component, financial assistance is provided for seed production, demonstration trials, and farmer training. For instance, farmers' training programs receive Rs. 15,000 per group of 50–150 farmers to educate them on seed production and post-harvest technologies. Another scheme is Rashtriya Krishi Vikas Yojana (RKVY). It offers subsidies for quality seeds, fertilizers, and irrigation equipment, aiming to enhance oilseed production, including Sesamum.

Agricultural extension services are pivotal in transferring technology and educating farmers. Initiatives like the Training and Visit (T&V) system have been instrumental in disseminating information on improved cultivation practices, pest management, and post-harvest handling to Sesamum farmers. ICT tools are increasingly employed to provide timely advisories and market information to farmers, enhancing their decision-making capabilities.

Access to credit and insurance is crucial for mitigating risks in Sesamum farming. Kisan Credit Card (KCC) Scheme provides farmers with timely credit for crop cultivation and other needs. It also includes risk coverage in the event of accidental death or disability. Pradhan Mantri Fasal Bima Yojana (PMFBY) offers crop insurance to protect farmers against losses due to natural calamities, pests, and diseases.

The MSP system ensures that farmers receive a remunerative price for their produce. MSP for Sesamum for the 2023–24 marketing season, the MSP for Sesamum was increased to Rs. 9,267 per quintal, reflecting a 7.3% rise from the previous year. The government has committed to setting MSPs at least 1.5 times the All-India weighted average cost of production, aiming to ensure a 50% return over production costs.

Despite the supportive policies, certain gaps hinder the optimal development of Sesamum cultivation. There exists a significant gap between research advancements and their adoption at the farm level, often due to inadequate extension services and lack of awareness among farmers. Farmers often face challenges in accessing markets, leading to distress sales. Strengthening market linkages and infrastructure is essential. Therefore, it is necessary to enhance the reach and effectiveness of extension services through capacity building and use of ICT tools. There should be improved access to quality seeds and inputs by strengthening supply chains and to develop robust market infrastructure to facilitate better price realization for farmers. We should encourage farmer producer organizations (FPOs) to aggregate produce and improve bargaining power.

Future Prospects and Strategies for Growth of Sesamum

The adoption of high-yielding, disease-resistant sesame varieties, coupled with optimized agronomic practices, holds significant potential for increasing production. For instance, the ICAR-Indian Institute of Oilseeds Research (IIOR) has developed region-specific varieties tailored to local climatic conditions, enhancing yield

stability. Implementing proper irrigation scheduling, especially during critical growth stages like flowering and capsule filling, can substantially boost yields.

Effective pest and disease management is crucial for sustainable sesame production. Integrated Pest Management (IPM) strategies, including the use of resistant varieties, biological control agents, and cultural practices, have proven effective. For example, employing neem-based formulations and fungal pathogens can control major pests like the sesame leaf roller and pod borer (Thakur *et al.*, 2024).

Additionally, the adoption of disease-resistant varieties and timely application of bio-pesticides can mitigate losses due to diseases such as phyllody and wilt.

Sustainable agriculture practices, including organic farming, conservation agriculture, and Integrated Nutrient Management (INM), are vital for long-term productivity. INM, which combines organic manures with chemical fertilizers, enhances soil fertility and crop yields. Moreover, organic practices, such as the use of bio-fertilizers and enriched compost, offer environmentally friendly alternatives that enrich soil health and reduce dependency on chemical inputs.

Organizing farmers into FPOs can enhance their bargaining power, facilitate access to quality inputs, and improve market linkages. FPOs can play a pivotal role in aggregating produce, enabling bulk sales, and reducing transaction costs. Developing robust value chains, including processing, storage, and logistics infrastructure, is essential for reducing post-harvest losses and ensuring better price realization for farmers.

Expanding the range of sesame-based products can open new markets and increase profitability. Value-added products such as sesame oil, tahini, sesame snacks, and health supplements are gaining popularity in domestic and international markets. The global sesame market is projected to grow significantly, driven by rising health consciousness and demand for plant-based products.

Investing in processing technologies and quality certification can help Indian sesame products meet international standards, thereby enhancing export potential.

Continuous investment in research and development is crucial for addressing emerging challenges in sesame cultivation. Areas of focus include developing climate-resilient and high-yielding varieties, improving pest and disease resistance, and enhancing post-harvest technologies. Collaborative efforts between research institutions, government agencies, and the private sector can accelerate innovation and dissemination of improved practices.

With the concerted implementation of these strategies, it is feasible to achieve a 20% increase in sesame production over the next five years, thereby enhancing farmer incomes and contributing to national oilseed self-sufficiency.

Conclusion and Recommendations

Sesamum cultivation in Tripura presents both opportunities and challenges. While the crop holds potential for enhancing rural incomes and diversifying agricultural practices, farmers face several obstacles such as Climatic Vulnerabilities, Pest and Disease Infestations, Limited Access to Quality Inputs, Inadequate Irrigation Infrastructure, Lack of organized markets and price instability and Post-Harvest Losses.

To address these challenges and promote sustainable sesame farming in Tripura, policy measures that are recommended include Strengthen Input Supply Chains, Enhance Irrigation Facilities, Implement Integrated Pest Management (IPM**),** and Establish regulated markets and support Farmer Producer Organizations (FPOs), Provide Post-Harvest Support, Expand financial services tailored to sesame farmers, including crop insurance schemes to mitigate risks.

With concerted efforts from all stakeholders, sesame cultivation in Tripura can be transformed into a lucrative and sustainable agricultural enterprise. By addressing existing challenges through targeted policies and community engagement, the state can enhance food security, boost rural incomes, and contribute to the overall development of its agricultural sector.

Fig: Field View of the Sesamum Cultivated under NFSM (Oilseeds) under KVK Sepahijala

ALLIGATOR WEED, AN IMPORTANT TRADITIONAL FODDER CROP IN MANIPUR AND ITS NUTRITIONAL CONTENT

Yengkhom Linthoingambi Devi[1], Joseph R Koireng[1], Punabati Heisnam[2], Bidya Ngangom[2]

[1]AICRP, FC & U, College of Agriculture, Central Agricultural University, Imphal, Manipur

[2]College of Agriculture, Central Agricultural University, Imphal, Manipur

INTRODUCTION

Alligator weed (*Alternanthera philoxeroides*) is an invasive plant which can grow both in dry and aquatic condition and is found mostly in subtropical and tropical regions of the world (Tanveer *et al.*, 2018). The plant has its origin from South America and spread to different parts of the world in a high pace due to its aggressiveness and higher adaptability of plant (Clements & Jones, 2021). The crop has been used in north eastern parts of India as potential livestock feed and it is even used for fish feeds (Suraiya *et al.*, 2024). But, scientific study of the crop is less in this area and there is no study conducted so far in north eastern states of India for its potential as a fodder and feed crop. Farming of fish species like grass carp, tilapia and certain freshwater prawns require continuous supply of plant-based feed. Also the conventional source of fish feed available in the market like fishmeal, soybean has environmental concerns so there is need to look for sustainable and alternative feed sources. Alligator weed is one such plant having high biomass with rapid growth of the plant. The plant is rich in essential amino acids, proteins and fibres along with good amount of vitamins and minerals (Li *et al.*, 2020). The plant also has high palatability and digestibility which make it an attractive feed component. Use of alligator weed can help in mitigating environmental impact of feed production and can contribute to its management.

Table 1: Nutritional Composition of Alligator Weed

Nutrient	Content per 100 g (Dry Weight)
Proximate Composition	
Crude Protein	18.5 g
Crude Fat	3.2 g
Crude Fiber	21.0 g
Ash	14.7 g
Carbohydrate	42.6 g
Minerals	
Calcium (Ca)	1,200 mg
Phosphorus (P)	310 mg
Potassium (K)	2350 mg
Magnesium (Mg)	320 mg
Sodium (Na)	45 mg
Iron (Fe)	35 mg
Zinc (Zn)	4.8 mg

Vitamins	
Vitamin A	1450 IU
Vitamin C	35 mg
Vitamin E	3.1 mg
Amino Acids	
Lysine	1.2 g
Methionine	0.4 g
Threonine	0.9 g
Valine	1.0 g

Fatty Acids	
Linoleic acid (Omega-6)	1.1 g
α- Linoleic Acid (Omega-3)	0.3 g

(Source Serdiati *et al.*, 2024)

Table 2: Phytochemical composition of Alligator Weed

Phytochemical	Content (g/100g dry weight)
Alkaloids	0.65
Flavonoids	2.35
Tannins	1.20
Saponins	1.75
Phenolic Compounds	3.80
Terpenoids	0.95
Glycosides	0.50
Steroids	0.45
Coumarins	0.30
Anthocyanins	0.20

(Source: Serdiati *et al.*, 2024)

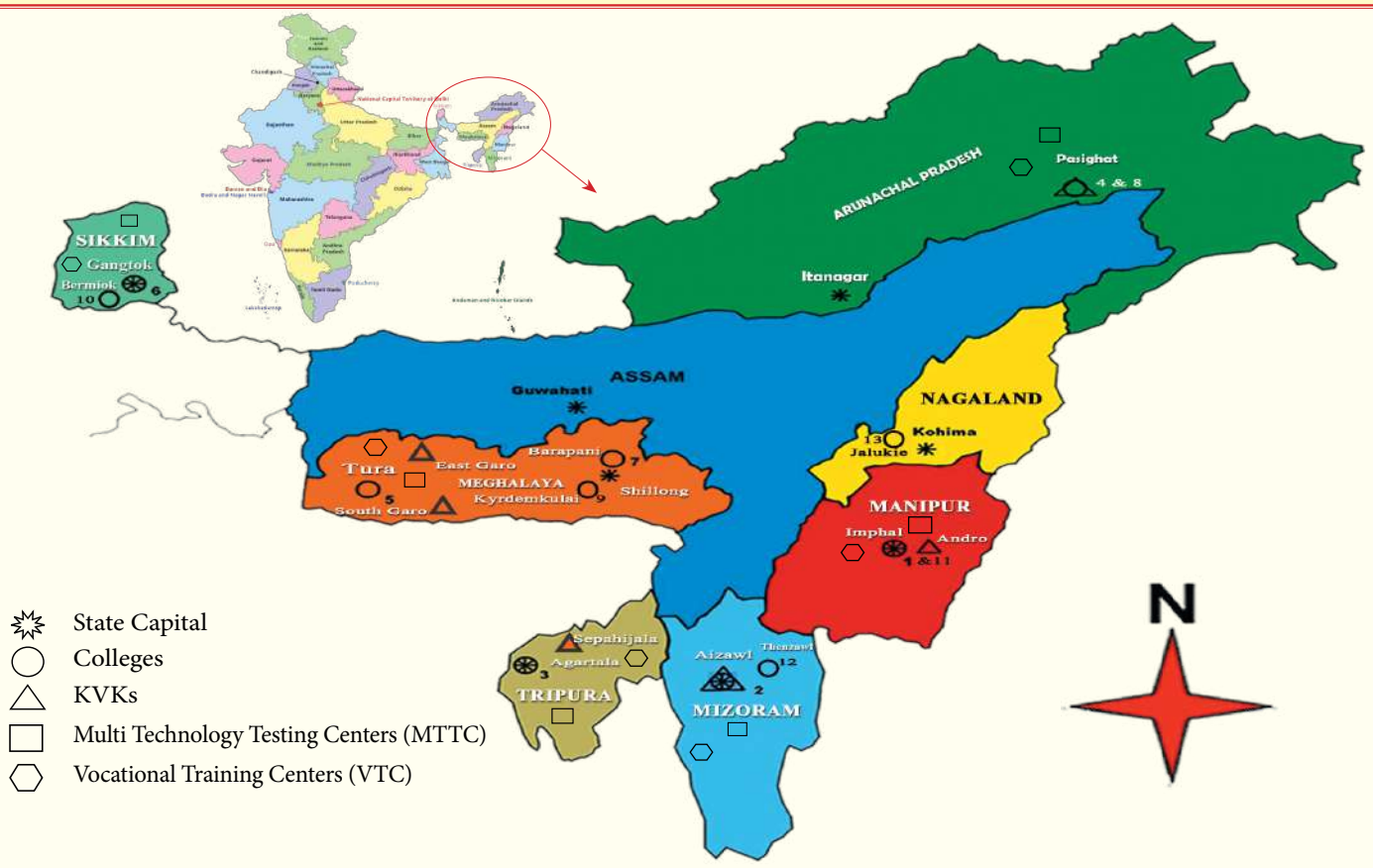
NUTRITIONAL CONTENT OF ALLIGATOR WEED

The crude protein content of the crop has around 18.5 g/100 g dry weight which is quite good. Protein is required by livestock animals for their growth and maintenance of body tissues. The plant also has high fibre content of 21.0 g which is beneficial for digestive health of the livestock animals. The ash content of 14.7 g is present indicating significance presence of inorganic minerals. Carbohydrate is the source of energy and the plant has about 42.6 g which is good amount for livestock animals. Alligator weed is also rich in minerals like potassium (2,350mg), calcium (1,200mg) and magnesium (320mg). Mineral like magnesium and calcium are required for metabolic functions and skeletal development of livestock animals while potassium plays important role in cellular functions and osmoregulation. The plant also has high content of vitamins like Vitamin A (1,450 IU), Vitamin C (35mg), Vitamin E (3.1mg) which is essential to maintain immunity and collagen synthesis of livestock animals. The important amino acids present in the plant are methionine (0.4g), lysine (1.2g), valine (1.0g) and threonine (0.9g). These amino acids are required for overall growth and protein synthesis of the livestock animals. Lysine and methionine also known for plant limited amino acids are also present which is beneficial for balanced nutrition. The fatty acid analysis showed the presence of α-linolenic acid (0.3g) and linoleic acid (1.1g) which are omega-3 and omega-6 fatty acids. These fatty acids helped in maintaining integrity of cell membrane, proper reproductive performance and anti-inflammatory responses. High protein content along with essential mineral and vitamins can support health, growth and productivity in livestock animals. The alkaloid content of the plant was around 0.65g per 100 g dry weight. The plant also has antioxidant property estimated by the presence of coumarin and anthocyanin at 0.30 and 0.20g/100g dry weight. Besides its antioxidant properties, it also has antimicrobial and anti-inflammatory activities. Anthocyanins are required for protecting plant and animal cell from oxidative stress and are effective for scavenging free radicals (Tena *et al.*, 2020). The plant shows a high level of phenotypic plasticity which enables the plant to survive in extreme environmental conditions (Tao *et al.* 2009). Alligator weed can adapt well in both wet and dry environment conditions. The plant can adjust the phloem fibre cell wall, hair density and collenchyma cell wall to adapt the plant under water logged condition (Ayi *et al.* 2016). The yield of biomass of alligator weed was unaffected by shaded condition (Bassett *et al.* 2011). Alligator weed also has high survival ability under any harsh environmental condition. Therefore, as the land area under fodder crops keeps on decreasing, the productivity of fodder crops needs to be increased. Alligator weed is one such plant having faster plant growth with good content of nutrients required for livestock animals and is found abundantly in north-eastern part of India. The crop has the potential to grow in wastelands, grasslands and wetlands. Also crop can be grown in polluted land area with enhanced nitrogen level as the crop can be benefitted from excess nitrogen found in environment (Ding *et al.* 2014).

CONCLUSION

Alligator weed is known for its fast growing ability, thus considered problematic weed for many important crops. But for fodder purpose, fast growing character of the plant may become a desirable trait as it gives a high biomass per plant. Proper standardization method is still needed for its scientific cultivation method if we have to grow as potential fodder crops in Manipur.

CENTRAL AGRICULTURAL UNIVERSITY, IMPHAL, MANIPUR



Constitutent Colleges,KVKs, VTCs & MTTCs of Central Agricultural University, Imphal

1. College of Agriculture, Imphal, Manipur
2. College of Vety. Sc. & AH., Selesih, Aizawl, Mizoram
3. College of Fisheries, Lembucherra, Agartala, Tripura
4. College of Horticulture & Forestry, Pasighat, Arunachal Pradesh
5. College of Community Science, Tura, Meghalaya
6. College of Agri. Engg. & PHT, Gangtok, Sikkim
7. College of P G Studies in Agricultural Sc., Umiam, Meghalaya
8. College of Agriculture, Pasighat, Arunachal Pradesh
9. College of Agriculture, Kyrdemkulai, Meghalaya
10. College of Horticulture, Bermiok, Sikkim
11. College of Food Technology, Imphal, Manipur
12. College of Horticulture, Thenzawl, Mizoram
13. College of Vety. Sc. & AH., Jalukie, Nagaland
14. Krishi Vigyan Kendra, Impahl East, Andro, Manipur
15. Krishi Vigyan Kendra, Aizawl, Mizoram
16. Krishi Vigyan Kendra, East Siang, Arunachal Pradesh
17. Krishi Vigyan Kendra, East Garo Hills, Meghalaya
18. Krishi Vigyan Kendra, South Garo Hills, Meghalaya
19. Krishi Vigyan Kendra, Sepahijala, Tripura

O Colleges (Total 13) * State Capital

△ KVKs (Total 6)

⬡ Vocational Training Centers (Total 6)

▭ Multi Technology Testing Centers (Total 6)

2279-8454

Book-Post

From

The Chief Editor
CAU Farm Magazine,
Directorate of Extension Education
Central Agricultural University
lamphelpat, Imphal - 795 004
(INDIA)

To

.....

.....

.....

.....