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REVIEW ARTICLE **OPEN ACCESS**

BHAGNA-SANDHANKAR KARMA (FRACTURE HEALING PROPERTIES) OF *KANGU* (FOXTAIL MILLET) *SETARIA ITALICA* – A REVIEW

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ABSTRACT:

Proper nutrition is an essential parameter of skeletal health, contributing in both the prevention and the treatment of bone diseases and fractures. Adopting a balanced diet, rich in nutrients, minerals, and vitamins, can contribute significantly to bone health. Food has always been an important way to treat illness and maintain health and hence Acharya Kashyap described food as *Mahabhaishyajya* (great medicine). Foxtail Millet is mentioned as *Kangu, Kanguni, priyangu* etc in ayurvedic texts. **Materials and methods**: Literature search was performed focusing on the nutritional aspects of bone health and fracture healing, using the following keywords: bone health, nutrition, fractures, bhagna sandhankar, kangu, foxtail millet. Discussion: *Foxtail millets is sweet and astringent to taste, that increases vata dosha but balances doshas related to pitta, kapha and blood tissues. It is described as bhagnasandhankar i.e. it is having fracture healing properties as per ayurvedic Samhitas.* ***Conclusion****:* According to ayurvedic properties helps in *Stambhan* (arrest bleeding). *Guru guna* provide proper nutrition and improves immunity during and after trauma. Hence consumption of foxtail millet following fracture or trauma may be helpful in *Bhagna Sandhankar* (fracture healing) effect.

KEY WORDS: *Fracture, Bhagna, Foxtail Millet, Kangu, Bhagna sandhan karma, fracture healing*

INTRODUCTION

Fracture is termed as "*Bhagna*" in Ayurved. Fractures occur in those patients with decreased bone strength and who experience an injury. Thus, the pathophysiology of fractures encompasses a multitude of factors that determine bone strength (bone mass, bone quality, age, skeletal geometry) and the frequency, nature, and effects of injuries. Each of these factors becomes more prevalent with advancing age, resulting in the exponential increase in the prevalence of fractures. [1] According to Ayurveda *Bhagna* may occurs due to the slipping, high pressure, sudden jerk, falling from height and other types of physical injury or trauma, etc. [2] The injury to the bony portion leads *Kanda Bhagna* while injury to the joints termed as *Sandhi Bhagna.* [3] The *Bhagna* not only affects bones but also affects muscles, ligaments and joints, etc. The basic procedures in treating a fracture are Traction (*Anchana*), Compression (*Peedana*), Immobilization (*Samkshepa*) and *Bandage* (Bandha). [4] Once a joint or fracture is reset and the deformity corrected, it regains its normal state by healing. Apart from this the role of nutrition in bone health is very much important. *Aahar* is one of the *Traya Upstambha* (pillar) in Ayurveda. [5] Ayurveda is having an concept that the health and disease both are the product of *Ahara.* [6] *Ahara* has been placed first which shows that it is most important to maintain and sustain the life. According to *Kashyap* Samhita, food as always been an important way to treat illness and maintain health and hence he described food as *Mahabhaishyajya* (great medicine). [7] Proper nutrition is an essential parameter of skeletal health, contributing in both the prevention and the treatment of bone diseases and fractures. Adopting a balanced diet, rich in nutrients, minerals, and vitamins, can contribute significantly to bone health. [8] Now a days Millets are getting popular amongst people due to their magical health benefits. They have high nutritional value and are rich in proteins, vitamins, minerals, and fibres. Millets are coarse grains that are traditionally grown and consumed in the Indian subcontinent for over 5000 years. But after Green revolution consumption of Millets decreased due to more accessibility of rice and wheat. One of the potential millets described in this article is Foxtail millet or *Kangu*. It is mentioned as *Kangu, Kanguni, priyangu* etc in ayurvedic texts. *Kangu* (Foxtail Millet) is also called as *Priyangu* which is *Trunadhanya* or *Kudhanya.* [9] But this is different from *Priyangu* i.e *Callicarpa macrophylla* which is from Verbinaceae family. [10] Foxtail millets is sweet and astringent to taste, that

increases *Vata dosha* but balances *doshas* related to *pitta, kapha* and blood tissues. It is described as *Bhagnasandhankar* i.e. it is having fracture healing properties as per ayurvedic Samhitas. [9] After trauma or fracture diet should lower inflammation, minimize muscle mass loss, manage weight, heals wound and prevent infections, combat with constipation due to medicines and provide strength. Hence in present study efforts has been made to find out *Bhagna sandhankar* (fracture healing) effect of Foxtail millet. Along with this critical review on ayurvedic and modern properties of *Kangu* or Foxtail millet has been described in this article.

Aim: to appraise the effect of *kangu* millet on fracture healing

Objective: 1. To critically review *Bhagna-sandhankar* karma of *Kangu* millet

2. To review about ayurvedic and modern concept of *Kangu* Millet

MATERIALS AND METHODS:

Literature search was performed focusing on the nutritional aspects of bone health and fracture healing, using the following keywords: bone health, nutrition, fractures, *bhagna sandhankar*, *kangu*, foxtail millet. All the research work regarding foxtail millet has been searched from science direct, PUBMED, scholar articles. various classical text of ayurveda and modern science has been reviewed.

***Bhagna* in Ayurveda**

Fracture is termed as "*Bhagna*" in Ayurved. *The word Bhagna is derived from the word bhanj-dhatu and Katupratyaya meaning to break. Bhanj means motion, which means to break.* Bhagna means breach/break in movements/ continuity of bone. [11] The term *'Bhagna'* refers to a wide range of musculoskeletal injuries. [12] Broadly *Bhagna* is classified into two types viz. Kanda *Bhagna* (Bone fractures) and *Sandhimukta* (Joints subluxations/dislocations). [13]

Etiological factors for Bhagna [2]

- *Pathana* (Slip or fall),
- *Peedana* (Pressure/Compression),
- *Praharaana* (Striking),
- *Akshepana* (Excessive movement),
- *Vyala mriga dashana abhighata* (Bite of ferocious animal)

Symptoms of Bhagna [14]

1. *Swayathu Bahulyam* (marked swelling),
2. *Sparshasahishnutvam* (tenderness),
3. *Vividha vedana* (different types of pain)
4. *Avapeedyamaney Sabda* (crepitus),
5. *Sarvasvasthasu Nasharmalabha* (inability to get comfort in any position), etc.

In case of *Bhagna* there is major vitiation of *Vata Dosha* and *Asthivaha strotas*

Prognosis: Acharya Susruta has described the prognosis of fractures in to *Sukhasadhya*, *Kastasadhya*, and *Asadhya* after considering the following points: Prognosis, Seasonal Variation, Age, Status of patient, Site of fracture, Status of *Asthi* and Type of fracture.[15]

Fracture in modern science

When a bone breaks, blood flows from any vessel torn by the fracture. The blood begins to clot, and about six to eight hours after the fracture, the clotting blood generate a hematoma. The disruption of blood flow to the bone results in the death of bone cells around the fracture. [16]

Healing of a bone fracture follows three phases: [17]

1. **Inflammatory phase**

It is the first stage of fracture healing which is also called as fracture hematoma formation stage. It occurs immediately after the injury. Within 48 hours after injury blood vessel torn by the fracture releases blood, this blood start to clot and forms a fracture haematoma. This inflammatory stage ends approximately one week after the fracture.

2. **The repairing phase**

The repairing phase begins within the first few days after the bone fracture and lasts for about 2 - 3 weeks. During this time, the body develops cartilage and tissue in and around the fracture site. The tissue callus forms at the broken ends of the bones. Their purpose is to stabilize the fracture. Following some weeks, a bony callus made of spongy bone called trabecular bone will replace the tissue callus.

3. Bone remodelling phase

This phase is the final phase in fracture healing. At this stage, spongy bones are replaced by solid bone which completes the healing process. In this stage, the outer surface of the bone remains slightly swollen for some time, which gets resolve on its own.

Kangu millet/ **Foxtail Millet**

Background

Foxtail Millet is an annual grass grown for human food. It is the second-most widely planted species of millet and the most grown millet species in Asia. India is the second-largest producer of foxtail millet, next to China. The crop has importance in the history and civilization of the human race in these two countries the oldest evidence of foxtail millet cultivation was found around 8,000 years before along the ancient course of Yellow river in Cishan, China. Foxtail millet predominantly cultivated in arid and semi-arid regions of the world. Foxtail millet was widely cultivated in the ancient era but it has lost its importance with time. [18] Foxtail millet is the second-most widely grown species in the world after Pearl millet. These tiny seeds around 2 mm in size,

covered in thin, crispy hull, usually available in light yellow-brown, rusty black go with the scientific name *Setaria italica*, is an annual crop grown in arid and semi-arid regions. Foxtail millet is a dry crop and is planted in the last week of May and it takes up to 70 days to harvest the crop. This is annual plant that grows erect with robust culms can reach up to 150 cm, with leaves extending to 40 cm in lanceolate shape. It is grown mainly in Andhra Pradesh, Karnataka, Telangana, Rajasthan, Maharashtra, Tamil Nadu, Madhya Pradesh and Uttar Pradesh besides few northeast states. [19] Foxtail millet like other millets is a powerhouse of nutrition. It is rich in Vitamin B12, protein, good fat, carbs and dietary fibre content. Besides copious amounts of lysine, thiamine, iron and niacin, it also offers abundant amounts of calcium.

Foxtail millet [20]

Vernacular names
Sanskrit name : *Kangu*
English name : *Foxtail millet*
Hindi name: Kanguni, kagani, Tanguni
Bengali name*: Kanguni*
Marathi name *: Kang, Rala*
Telugu name *: Koralu Korra*
Tamil Name: *Thinai, KavalaiKambankorai, Nuvanam*
Gujarati name: *Kanga*
Kannada Name*: navane, navanakki*
Panjabi Name*: Kangni*
Malayalam Name*: Thina*
Nepali Name: *Kaguno*

Botanical classification of Foxtail millet [21]

Super division: Spermatophyta
Division: Magnoliophyta
Class: Liliopsida
Subclass: Commelinidae
Order: Cyperales
Family: Poaceae
Genus: Setaria
Species: italica
Botanical name: Setaria italica

Fig. 1 Foxtail millet

Fig. 2 Seeds of Foxtail millet

Taste *:* *Kashaya, Madhura,* (sweet, Astringent)

Guna :

Ruksha (dry in nature)

Ruchya (improve taste)

Guru (heavy to digest)

***Virya* (Potency):** *sheeta* (cold)

Effect on body:

Bhagna sandhankar (heals fracture)

Bruhani (nourishes)

Dahagna (relieves burning sensation)

Vajinaam (good for horses)

Effect on tridosha

Decrease *Kapha dosha*

Increase *vaata dosha*

Nutritional components Value per 100 g [23]

Energy	331 kCal
Protein	12.3 g
Dietary fibre	8 g
Fat	4.3 g
Phosphorus	290 mg
Potassium	250 mg
Magnesium	81 mg
Vitamin A	32 mg
Calcium	31 mg
Vitamin E	31 mg
Folic acid	15 mg
Sodium	4.6 mg
Niacin	3.2 mg
Iron	2.8 mg
Zinc	2.4 mg

DISCUSSION

The basic procedures in treating a fracture are Traction (*Anchana*), Compression (*Peedana*), Immobilization (*Samkshepa*) and Bandage (*Bandha*). Once a joint or fracture is reset and the deformity corrected, it regains its normal state by healing. Apart from this the role of nutrition in bone health is very much important. Proper nutrition is an essential parameter of skeletal health, contributing in both the prevention and the treatment of bone diseases and fractures. Adopting a balanced diet, rich in nutrients, minerals, and vitamins, can contribute significantly to bone health. During the treatment of fracture specific treatments or medicines are advised which may get side effects such as constipation. After fracture the lack of movement required to promote initial recovery; but it may result in loss of muscle mass and strength, and the time required for recovery may take several months. So eating foods which helps body to decrease inflammation, minimize muscle mass loss, heal wounds and manage weight will help toward a rapid recovery. Foxtail millet is loaded with nutrition. Further discussion on ayurvedic and modern properties of foxtail millet in fracture healing action has been discussed.

Discussion on ayurvedic properties of Foxtail millet

Foxtail millet is *Kashaya* and *Madhura* in rasa. *Kashaya rasa* is *ruksha* (dry in nature), *sheet* (cold in potency) and *laghu* (light to digest). Hence its mode of action is *Shoshana* (dries up moisture), *Ropana* (healing action), *Kapha dosha shamaka* and *Stamban* (arrest bleeding). [24] There are Multiple references of use of *Madhura dravyas* noted in fractures related disorders and surgical cases. *Madhura Dravya* uses can be noted in *Atipravritta Rakta Sthaapana* Upaaya of *Shushruta Samhita*. *Kakolyadi Gana Kashaya* sweetened with *Madhura Dravya* like *Sharkara* and *Madhu* given to drink, after bandaging and other measures for arresting blood flow after bloodletting. [25] Hence *Madhura rasa* can be effective in arresting blood. Foxtail millet is having *Guru guna* i.e., heavy quality. It contributes to weight and gravity of substance. *Guru guna* with *Madhura* and *Kashaya rasa* helps in *Bhrumhana* karma [26] i.e., it maintains nutrition of the body by improving immunity. Immediately following the trauma, haematoma occurs. The injury initiates an inflammatory response which is necessary for the healing to progress. These properties of Foxtail millet may help in healing process. Foxtail millet is having *Ruchya* property i.e., it improves taste. During or after trauma or fracture better nutrition is required. For that *ruchya* property of foxtail millet will be helpful; in palatability and balanced consumption of its recipes. Foxtail millet is *Ruksha* i.e., dry in nature. Hence it can increase Vata dosha. For this it can be prepared using any oil so that *vata shamana* can be done. Consumption of foxtail millet recipe can be limited to once a day for minimising the *vata prakopa*. Foxtail millet is *Sheeta* (cold) in potency. Power or internal strength with which a substance performs its actions are called as *veerya* or potency. *Sheeta veerya* of foxtail millet will help in providing stability, strength and may prevent discharges during or after trauma. [27] Foxtail millet is said to be *Bhagna Sandhanhkar* i.e., it helps in healing fractures. From the properties of foxtail millet like *Madhura* and *Kashaya* rasa, *Sheeta veerya*, *Guru Guna*, and *Ruchya Guna*, we can understand the fracture healing action of foxtail millet. Foxtail millet is having *Bhrumhama karma* due to its *Madhura Kashaya rasa* and *Guru guna*. So it improves nutrition of the body. Foxtail millet is having *Dahagna* i.e. it relives burning sensation.

Discussion on modern properties of foxtail millet

Foxtail millet is highly nutritious as compared to conventional cereals. Foxtail millet diets provides an overall calorie of 349 Kcal per 100 grams. This millet possesses 30.10 mg/100 g of calcium and 3.73 mg/100 g

of iron. Foxtail millet is rich in protein content as well as it contains a good amount of fat and fiber. It contain 11.20g of protein and it also has a higher dietary fiber of 4.42 g. Foxtail millet is free of gluten.[28] The overall protein content in foxtail millet is 11.20 g. When there is a fracture, the body needs protein to build new bone for the repair. It also facilitates the body's absorption and utilization of calcium. [29] Foxtail millet diet consumption provide good number of proteins during and after fracture or trauma. Foxtail millet possesses 30.10 mg/100 g of calcium. Calcium helps in building strong bones which can help in bone fracture healing. Foxtail millet possesses 3.73 mg/100 g of iron. After a fracture Iron assists the body in producing collagen for bone regrowth. It also contributes to the delivery of oxygen to the bones, which supports in bone healing. Foxtail millet diet aids in bone healing. Foxtail millet also has a higher dietary fiber of 4.42 g. During the treatment of fracture specific treatments or medicines are advised which may lead to side effects such as constipation. Foxtail millet diet can provide high fiber to combat constipation. Foxtail millet possesses 250 mg/100 g of potassium. This mineral prevents the body from losing calcium through urine.[30] The study performed on Foxtail millet indicates that bound polyphenols of inner shell (BPIS) from foxtail millet bran can display anti-inflammatory effects in LPS-induced HT-29 cells and in nude mice. Mechanistically, BPIS restrained the level of various pro-inflammatory cytokines (IL-1β, IL-6, IL-8), and enhanced the expression level of anti-inflammatory cytokine (IL-10) by blocking the nuclear factor-kappaB (NFκB)-p65 nuclear translocation. [31] So consumption of foxtail millet diet may lead to anti-inflammatory action which may reduce pain and swelling during trauma or fracture.

Cautions: Millets need to be cooked well for deriving full benefits, however, this particular millet should never be mixed with milk, as it may cause severe indigestion.

Recipes of Foxtail millets: foxtail millet Upama, Vegetable Pulav, biriyani, kheer, foxtail millet flour chapati, bhakari, idli, appum, dosa

CONCLUSION

Though Foxtail millet is powerhouse of nutrition, it is a neglected and under-utilised crop. Besides, its role of fracture healing is rarely known. Foxtail millet has potential nutritional and health benefits. It is rich in protein, calcium, fiber minerals and anti-oxidants which are essential for fracture healing. It is low in fat content. According to ayurvedic properties helps in *Stambhan* (arrest bleeding). *Guru guna* provide proper nutrition and improves immunity during and after

trauma. Hence consumption of foxtail millet following fracture or trauma may be helpful in *Bhagna Sandhankar* (fracture healing) effect. So foxtail millet diet can be effective in a the phases of fracture healing like repairing phase and remodelling phase. First two weeks there is inflammatory phase which is important for callus formation. As according to one study Foxtail millet bran possesses anti-inflammatory action, so foxtail millet diet may interfere this phase. Hence foxtail millet diet may be given after inflammatory phase i.e after 10 – 12 days. Thought more clinical research is required for this fact. Its significance may be observed if a study performed in large number of samples.

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