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## PHARMACOGNOSTIC EVALUATION OF *SETARIA ITALICA* L. CARYOPSIS - A NUTRITIONAL AND THERAPEUTIC MILLET IN AYURVEDA

Talat Anjum, Sonam Tamchos, Sanjay Kumar Singh and Subash Sharma

Regional Ayurveda Research Institute (CCRAS), Bantalab, Jammu - 181123, Jammu and Kashmir, India.

### Keywords:

*Setaria italica*, Ayurveda, Pharmacognosy, TLC, Microscopy

### Correspondence to Author: Mrs. Talat Anjum

Research Officer (Botany),  
Regional Ayurveda Research Institute  
(CCRAS), Bantalab, Jammu - 181123,  
Jammu and Kashmir, India.

**E-mail:** talatanjum11@gmail.com

**ABSTRACT:** *Setaria italica* L. is one of the world's oldest crops, which has been cultivated and domesticated about 8000 years ago. It is known for its ecological, nutritional and medicinal properties. In Ayurveda, it is called *kangu/priyangu* and is believed to nourish the body tissues and absorb excessive fluids besides, widely used in the treatment of various disorders. Since, no reports are available on microscopical and phytochemical studies of the caryopsis of *Setaria italica* L., hence, the present study was undertaken to investigate the same. Pharmacognostic and preliminary phytochemical study of the caryopsis of *Setaria italica* L. were carried out using microscopy, physicochemical analysis and TLC. The microscopy shows the presence of tube cells and cross cells, starch grains devoid of hilum, and occurring singly or in aggregates, tangentially elongated cells of pericarp, and endospermic cells filled with aleurone grains. The physicochemical analysis shows 8.33% w/w LOD, 3.10% w/w, Ash value and 7.83pH. TLC did not show any colour at UV 254 and 366 nm however, three brownish colour bands of Rf values (0.4, 0.44, and 0.47) are found in derivatised with Vanillin-Sulphuric acid. The result obtained from pharmacognostic studies and chemical fingerprints could be used as standardization data of the caryopsis of *Setaria italica* L., to apply or provide for guarantee of its quality.

**INTRODUCTION:** Foxtail millet (*Setaria italica* L.) is a member of Poaceae family. It is an annual, erect herb, 0.6-1.5 m tall, widely cultivated in many parts of temperate and tropical countries of Africa, America and Asia<sup>1-2</sup>. The plant is native of China, and it is regarded as one of the world's oldest cultivated crops that was domesticated about 8000 years ago<sup>3</sup>. It is considered as one of the important millets which is drought resistant, capability to survive under stressful climatic conditions, resistance to pests and diseases, matures in shorter period than cereals<sup>4-5</sup>.

The crop is adapted to different biotic and abiotic factors like salinity and fungal infection<sup>6-7</sup>. Due to some distinct characteristics, such as short life cycle, short height, self-compatibility, adequate seed production per plant, true diploid nature ( $2n = 18$ ), and small genome size make *Setaria italica* L. and its ancestor *Setaria viridis* (green foxtail) a perfect model plant to many scientists<sup>3</sup>. Like maize and sugarcane, foxtail millet and green foxtail are typical C4 plants and are used for the study of photosynthesis by many researchers<sup>1, 6, 8-11</sup>.

Foxtail Millet is nutritionally and medicinally important as it is rich in antioxidants and numerous macro- and micronutrients. Presence of these required nutrients makes it potential dietary supplement<sup>12-13</sup>. Ayurveda classics classify millets among a specific group of *Dhanya*, i.e., *Kshudradhanya* or *Kudhanya*, or *Trundhanya*. This

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*Dhanya Varga* (group of grains) encompasses the properties of having *Kshaya*, *Madhura Rasa*, *KatuVipaka*, *Sheeta Veerya*, and *Ruksha Guna*. Owing to these *Gunas*, the *Kledshoshak* (absorption of excess fluid) and *Pitta raktaka phahara* properties are predominant, along with *Vatkrit* (aggravation of *Vata*) and *Baddhvitaka* (causing reduction in faeces) actions<sup>14</sup>. *Kangu Dhanya/Priyangu* is one among these, which possesses the *Bhagnsandhankara* (fracture healing), *Brumhana* (nourishment of body tissues)<sup>15-16</sup>, *Durjara* (difficult to digest)<sup>16</sup> and *Sleshmaha* (reduces *Kapha*) properties as a result of its *Ruksha* nature.

It has good nutritional, nutraceuticals and bioactive components<sup>17</sup>. The Phytochemical compounds such as dietary fibre, fatty acid, resistant starch, phenolic compounds, phytosterols, tocopherol present in this millet are responsible for bioactive properties<sup>18</sup>. The Foxtail Millet is high in Vitamin B12, which is important for maintaining a healthy heart and nervous system. It also aids in improving the state of glycemic control and the reduction of insulin, cholesterol, and fasting glucose in Type 2 diabetes<sup>19</sup>. In ethnobotany, it is used in the treatment of measles and chicken pox<sup>20</sup>. In present paper pharmacognostic study of caryopsis has been reported for the first time. Ultrastructure and powder characters of this valuable millet have been highlighted for its identification in future.

**Morphology of Fruit:** Fruit is a ridged caryopsis upto 3.0 mm long and 0.5 mm – 1.0 mm wide, narrow, ellipsoidal tapering at both ends. Surface is hispid hairy and consist of tightly enclosed boat shaped pericarp which is 5-nerved, golden yellow or yellowish brown in colour. Lemma is usually awned and edges of awns are rough or barbed. Seed is smooth, oval to oblong, oblique enclosing very small embryo on the ventral side.

## MATERIALS AND METHODS

### Collection and Authentication of the Sample:

Authentic sample of dried seed of *Setaria italica* L. was procured from CARI Bangalore, one of the peripheral Institutes of Central Council for Research in Ayurvedic Sciences (CCRAS), Ministry of AYUSH, Govt. of India. Botanical binomials and family details of the whole plant were confirmed from the Flora British India<sup>21</sup>.

Sample has been preserved in RARI, Jammu Museum bearing accession number RARI-JM-078.

**Section Cutting:** The dried caryopsis was soaked in water for 15-30 minute for softening the outer tissue. Transverse sections were hand cut with a sharp razor blade.

**Preparation of Powder:** Fine powder was prepared from the dried sample using a mixer grinder. The powder was strained using 60 No. sieve (as per the standard procedure). The final filtered powder was then used for the study.

### Microscopy and Powder Analysis:

Pharmacognostic studies were carried on dried raw drug samples by standard method as mentioned in Ayurvedic Pharmacopoeia of India, Part-I, Vol-I, Ministry of AYUSH, Govt. of India. The macroscopic features were noted as visualised with naked eye and stereo-microscopic observations using Olympus SZ2-ILST. Microscopy of the sample was carried out by standard methods under different magnifications using Olympus trinocular microscope CX41. Free hand sections were cleared with distilled water and observed under microscope. No stains were used, photographs of magnifications of the figure are represented by the scale-bars. The histochemical studies were carried out for the sample tissues and microphotographs were taken. Powder microscopy was carried out to observe the diagnostic character of sample.

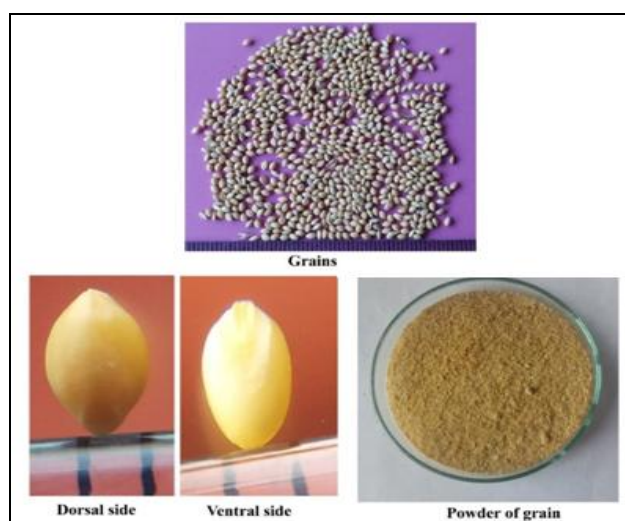
**Physicochemical Analysis:** Physicochemical parameters like pH, Loss of drying, Ash, Aqueous soluble extractive value, Alcohol soluble extractive value, Acid insoluble ash and foreign matter were computed according to the method prescribed in Ayurvedic Pharmacopoeia of India (API).

**TLC Methodology:** 4 g of sample were soaked overnight with 40 ml of ethanol, boiled, filtered and made up to 10 ml volumetric flask. The sample solution 5 µl, 10 µl was applied on Tracks-1& Track-2 respectively on an E. Merck aluminium plate pre-coated with Silica gel 60F254 of 0.2 mm thickness using ATS4 applicator. The plate was developed in the solvent system of Toluene: Ethyl acetate = 9:1 upto 90 mm and dried. The plate was observed through CAMAG TLC Visualizer under UV at 254 nm and 366 nm photos were taken.

Finally, the plate was dipped in Vanillin-Sulphuric acid reagent and heated in hot air oven at 105 °C until the colour of the spots appeared, and photo was documented.

## RESULTS AND DISCUSSION:

**Macroscopy of the Caryopsis:** The caryopsis of *Setaria italica* L. has following diagnostic features **Fig. 1**.



**FIG. 1: CRYOPSIS OF SETARIA ITALICA L. AND ITS POWDER**

**Appearance:** A ridged caryopsis narrow, ellipsoidal, surface hispid hairy; lemma usually awned, seed smooth.

**Shape:** Oval to oblong, oblique

**Size** -2.8-3.0mm long and 0.5mm – 1.0mm wide

**Texture:** Smooth

**Microscopic (Seed):** T.S. of *Setaria italic* L. caryopsis is more or less heart shaped in outline and shows outermost layer of pericarp, followed by aleurone layer encircling the endosperm.

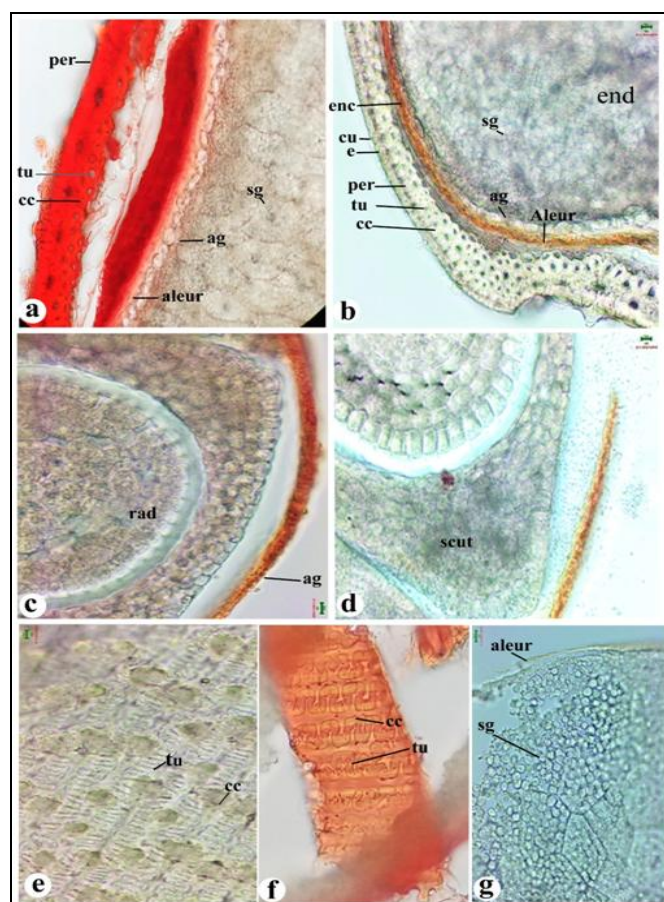
Detailed T.S of the caryopsis of *S. italica* shows outer coat composed of epidermis of the pericarp covered with cuticle. It is followed by tube cells and cross cells. Cross cells are oriented transversely to the long axis of the caryopsis and tube cells lie parallel to the long axis. Both these cells have thick walls with simple pits. The testa or seed coat is reduced to a thin layer, brownish in colour and it is followed by aleurone layer composed of a single layer of cubical cells which envelops endosperm. Endosperm and embryo occupy most part of the

grain. Endosperm consists of polygonal cells packed with starch grains. The starch grains are oval, small without any striations and lack a hilum **Fig. 2**. The surface view of the epidermis shows parallel rows of sclerified cells, composed of tube cells and cross cells **Fig. 2**.

### Powder Analysis:

**Organoleptic Study:** Powder of *S. italica* L. is smooth in texture and appears dark creamish in colour. Odour is pleasant and tastes sweet.

**Microscopy:** Powder of *S. italica* L. shows single and compound starch grains oval in shape and with narrow lumen. Groups of tangentially elongated cells of pericarp, tube cells and cross cells in surface view and fragments of endospermic cells filled with aleurone grains **Fig. 3**.



**FIG. 2: T. S (A-D) AND SURFACE VIEW (E-G) OF THE CARYOPSIS OF SETARIA ITALICA L. THE PHOTOGRAPH OF THE CARYOSIS INCLUDES PERICARP (PER), ALEURONE LAYER (SLEUR); CUTICLE (CU), EPIDERMIS (E), ENDOCARP (ENC), TUBECELL (TU), ENDOSPERM (END), CROSSCELL (CC), PERICARP (PER), SCUTELLUM (SCUT), RADICLE (RAD), ALEURONE GRAINS (AG) AND STARCH GRAIN (SG)**

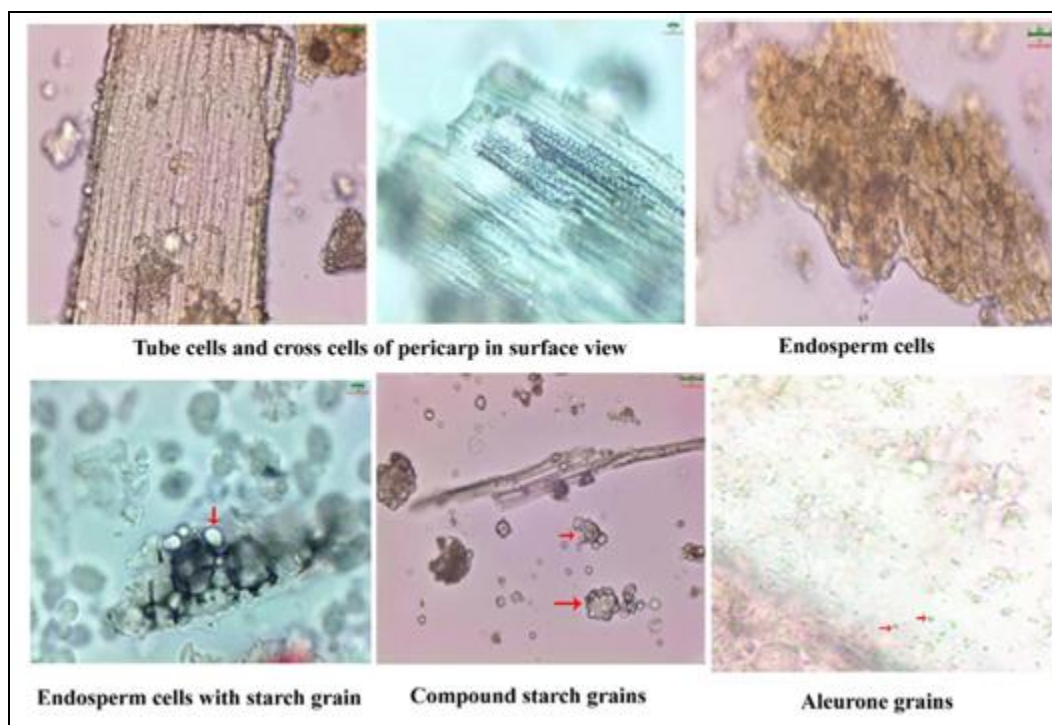


FIG. 3: MICROSCOPIC CHARCTERS OF *SETARIA ITALICA* L.

**Physicochemical Properties:** The results of physicochemical analysis of *S. italica* L. are mentioned in **Table 1**. The foreign matter is present < 2%; whereas the Loss on drying, ash value and Acid insoluble ash were calculated 8.33%, 3.10% and 1.47% respectively. The Extractive value for aqueous and alcohol were 3.76% and 5.45% respectively.

TABLE 1: PHYSICOCHEMICAL CONSTANTS OF *S. ITALICA* L.

S. no.	Test parameter	Results of <i>Setaria italica</i> L. in % w/w
1	Foreign matter	Less than 2
2	LoD	8.33
3	Ash value	3.10
4	Aqueous soluble extractive value	3.76
5	Alcohol soluble extractive value	5.45
6	Acid insoluble ash	1.47
7	pH (4% aqueous solution)	7.83

**Thin- Layer Chromatography:** Results of TLC reveals the Rf values and colour of the resolved bands **Fig. 4A**. No Rf value and colour was indicated in 254 and 366 nm of UV light. However, three Rf values (0.40, 0.44 and 0.47) and brownish colour were Derivatised with Vanillin-Sulphuric acid for the ethenol extract of seed of *Setaria italica* L. Both the tracks show similar band, and all three spots are found below 0.5 **Fig. 4B**.

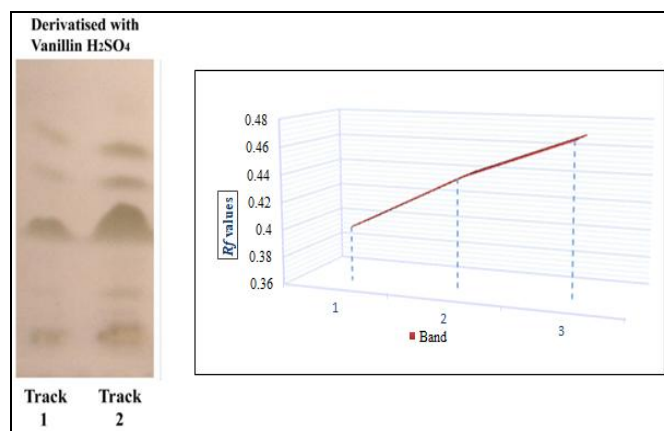


FIG. 4: (A) TLC IMAGE OF *SETARIA ITALICA* L. CARYPOSIS EXTRACT AND (B) RF VALUE OF EXTRACTS

**CONCLUSION:** Keeping in view the importance of millets due to its nutritional value and health benefits as mentioned in Ayurveda and growing use to beat lifestyle disorders, standardization of this important millet is essential for ensuring its purity, quality and sample identification. Macroscopy and microscopy along with the Quantitative analytical microscopy are one of the simplest and cheapest methods for establishing the correct identity of the source material.

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