




Physical seed dormancy in *Abrus precatorius* (Ratti): a scientific validation of indigenous technique

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Abstract

Seeds of *Abrus precatorius* L. (Fabaceae) were used as weight measure by Indigenous people. Where, the seeds were referred as Ratti; a traditional Indian unit of mass measurement. Seed weight fluctuates depending upon age, moisture, storage-period/conditions. Therefore, use of seeds as a weighing unit become dubious and need to be validated. For this purpose, seeds of *A. precatorius* were subjected to different moisture conditions and periodically monitored. Surprisingly, there was no change in seed weight was observed, indicating the impermeability of seed coat. The later was confirmed by scarification of seed coat which resulted in 53% increase in seed weight against 0% in control. Further, presence of a potent toxin (abrin) in the seed coat protects it from pests and microbes, and contributes to the maintenance of impermeability for longer period of time. The data validates the use of *A. precatorius* seeds as a weighing unit (ratti) by the indigenous people and discussed.

Keywords: *Abrus precatorius*; ITK-validation; Physical dormancy

1. Introduction

Indigenous techniques (ITKs) are treasure troves of ancient wisdom and developed through trial-and-error, experiences gained over the centuries, and are time tested (Mohapatra, 2018) but, generally not substantiated by any scientific evidences. Seeds of *Abrus precatorius* L. (Fabaceae) an indigenous medicinal plant commonly known as Rosary pea, Ratti or Gunja are very attractive, uniform in size and shape (Fig. 1) and are used as weight measure by indigenous people including Indian gold smiths. Where, the seeds were referred as Ratti, a traditional Indian unit of mass measurement (Shrivastava, 2017). Generally, seed weight changes or fluctuate with change in environmental conditions (temperature, relative humidity), storage-period and storage-conditions (McGilp et al., 2020). Further, seeds weight generally decline with the progression of storage/ageing due to metabolic breakdown of stored food, microbial degradation, pest infestation, and also due to bear-and-tear (Baskin & Baskin, 2000). Therefore, the use of *A. precatorius* seeds as a weighing unit especially, where precious metals (gold, silver, platinum), stones and gems have to weigh become dubious and need to be scientifically validated. The later has never been doubted nor scientifically validated ever.

2. Objective

The objective of the present study was to find out the rationale behind the use of *A. precatorius* seeds as a weighing unit by Indigenous people and to scientifically validate the indigenous technique.

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Figure 1. *Abrus precatorius* (Ratti) seeds.

3. Methods

Fully ripened and viable seeds of *A. precatorius* collected from Kangra, Himachal Pradesh, India were used in this experiment. Seed viability was determined through TTC (2,3,5-triphenyl tetrazolium chloride) reduction test. To monitor the change in seed weight, seeds were subjected to different moisture conditions (soaked in distilled water, placed on moist substratum, kept in a container with high relative humidity, kept in desiccator) and also acid scarified with concentrated H_2SO_4 for different durations *i.e.* 0, 30, 60, 90, 120, 150 min., washed thoroughly and soaked in distilled water for 24 h and periodically monitored for any change in weight. In another set of seeds were mechanically scarified at chalazal end with the help of sand paper were also monitored. Further, seeds were transferred to petri-plates lined with moist substratum for germination. Data are presented as arithmetic mean of 100 seeds each. The significance of difference was assessed based on the Student's *t*-test.

4. Results and discussion

The seeds of *A. precatorius* showed 100% viability. The later was confirmed by both TTC reduction test and seed germination (98% germination). To evaluate the validity of ITK, seeds were subjected to different moisture conditions. Surprisingly, there was no change in seed weight was observed even after 48 h of exposure to the above conditions (Tables 1, 2). The seed weight remains constant, indicating the complete impermeability of seed coat towards water and air. In contrast, the seed weight of *Cicer arietinum* L. (used for comparison purpose, procured from IARI, New Delhi, India) increased significantly with increase in relative humidity/moisture (Table 2). The findings strongly supported the use of *A. precatorius* seeds as a weighing unit. To confirm the impermeability of seed coat toward water the seeds were mechanically (through sand-paper) as well as chemically (conc. H_2SO_4) scarified. The treatments effectively removed the impermeability of seed coat and resulted in significant increase in seed weight and of course resulted in further germination (Table 1). Seed dormancy in *A. precatorius* is known (Nautiyal & Singh, 2015) but, the type of dormancy has never been classified. According to the new seed dormancy classification by Baskin and Baskin (2004), the type of dormancy exhibited by *A. precatorius* seeds in present study should be classified as physical dormancy (PY). Physical dormancy is caused by water-impermeable seed coat due to the presence of one or more palisade layers of lignified malphigian cells (macrosclereids) tightly packed together and impregnated with water-repellant chemicals and known to occur in some 15 plant families including the Fabaceae (Baskin et al., 2000). In nature, seeds with physical dormancy remain dormant until some factors (high temperature, widely fluctuating

Table 1. Effect of acid- (concentrated H₂SO₄) and mechanical-scarification of seeds on seed coat permeability in *Abrus precatorious* L. Data are average of 100 seeds each, all the differences are significant at $p \leq 0.01$.

Treatments	Acid (H ₂ SO ₄) Scarification (Minutes)						Mechanical Scarification
	Control	30	60	90	120	150	
Seed weight (mg)	116.85	134.38	158.24	171.44	178.69	186.36	172.34
Water uptake (%)	0	15	35.42	46.7	52.9	60.21	47.48
Germination (%)	0	34 (± 4)	56 (± 5)	78 (± 6)	98 (± 2)	74 (± 4)	82 (± 10)

Table 2. Comparison of change in seed weight of *Abrus precatorious* L and *Cicer arietinum* L as affected by different relative humidity. Data are average of 100 seeds each. All the differences are significant at $p \leq 0.01$.

Treatments	Relative Humidity (%)				
	0	50	100	Soaked in DW (24 h)	
<i>A. precatorious</i>	Seed weight (mg)	116.98	117.04	116.96	117.04
	Change in seed weight (%)	0	0	0	0
<i>C. arietinum</i>	Seed weight (mg)	170	178	183	366
	Change in seed weight (%)	0	4.15	7.25	114.3

temperature, fire, drying, freezing and passage through the digestive tracts of animals) render the covering layers permeable to water (Baskin, 2003). In the present study, the seeds of *A. precatorious* required more than 2 hours of acid (conc. H₂SO₄) scarification to achieve maximum water uptake and seed germination (Table 1). The later indicates the depth of physical dormancy in *A. precatorious*. Physical seed dormancy can also be affected by microbial action and abrasion by soil particles (Baskin & Baskin, 2000). However, the presence of abrin, a potent toxin similar to ricin but even more poisonous, in the seed coat of *A. precatorious* (Dickers et al., 2003; Zhang et al., 2019) protects the seed from pests and microbes, which eventually contribute to the maintenance of impermeability of seed coat/physical dormancy (thereof constant seed weight) for longer period of time. In addition, the smooth, glossy and shiny seed coat significantly reduces the chances of bear and tear/abrasion by soil particles during long run, which further strengthen and validates the ITK. Thus, the present study strongly confirms and validates the use of *A. precatorious* seeds as a weighing unit (ratti) by indigenous people and is reported first time.

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Conflicts of interest. None.

Data Availability. Data will be provided whenever requested.

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Peer Reviews


Reviewing editor: Dr. Ali Bajwa

NSW Department of Industry, Wagga Wagga, New South Wales, Australia, 2650

This article has been accepted because it is deemed to be scientifically sound, has the correct controls, has appropriate methodology and is statistically valid, and has been sent for additional statistical evaluation and met required revisions.

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Review 1: Physical seed dormancy in *Abrus precatorious* (Ratti): a scientific validation of indigenous technique

Reviewer: Dr. Nadeem Iqbal 

Date of review: 05 November 2020

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Conflict of interest statement. I declared that I have no conflict of interest with this paper

Comments to the Author: Overall, a very well written paper on an important subject. The study was well designed and executed taken into account all important parameters. Results were appropriately described and discussion was up to the mark. However, it needs some improvement in introduction section. Goals/objectives are not clearly defined and followed throughout the manuscript. Also, abstract should indicate data from results and discussion section.

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Review 2: Physical seed dormancy in *Abrus precatorious* (Ratti): a scientific validation of indigenous technique

Reviewer: Dr. Shah Fahad 

Date of review: 15 November 2020

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Conflict of interest statement. Reviewer declares none

Comments to the Author: This is a paper which reviews the role of seed dormancy in *Abrus precatorious*. The author has done good work. However, the actual text needs a lot of work I feel. I have the following comments, but they are not exhaustive, I could have pointed out more. However, I hope my comments will help the overall feel of the paper.

1. Title should be modified.
2. English should improve by a native person. The paper suffers from a poor English structure throughout and cannot be published or reviewed properly in the current format. The manuscript requires a thorough proofread by a native person whose first language is English. The instances of the problem are numerous and this reviewer cannot individually mention them. It is the responsibility of the author(s) to present their work in an acceptable format. Unless the paper is in a reasonable format, it should not have been submitted.
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