

BANGLADESHI *TERMINALIA CHEBULA* SEED: PHYTOCHEMICAL CONTENT, PROXIMATE AND MINERAL COMPOSITIONS

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ABSTRACT

The current study set out to examine the mineral content, phytochemical composition, and proximate composition of *Terminalia chebula* seeds. Moisture content (9.13%), ash (4.15%), organic matter (94.05%), crude protein (13.56%), dry matter (90.87%), crude fiber (8.87%), carbohydrate (41.42%), and nitrogen (2.17%) were the findings of the proximate analysis. Findings of the research showed that, water soluble ash was 60.03% and rest of the part water insoluble. In the case of acid soluble ash, 92.01% was acid soluble. The seed's calorific values were determined to be 269.06cal/gm. Alkaloids, saponins, and flavonoids are examples of phytochemicals that were present and contributed to the plant's therapeutic effects. An adequate quantity of vital minerals, including Cu, Zn, K, Ca, Na, Fe, Mg, Al, Mn, Ni, Pb, Cr, Cd are present in seeds. Potassium had the highest cc concentration (106.82 mg/g) and Cadmium had the lowest (0.0001 mg/g), according to the mineral elemental concentration test.

KEYWORDS: Mineral compositions, atomic absorption spectrophotometers, proximate analysis, and *Terminalia chebula*.

1. INTRODUCTION

Malnutrition is currently a problem for individuals in developing nations, particularly for pregnant women and children living in rural areas. Essential components for plant and animal nourishment are found in food (Omorayi *et.al.*, 2007). Small yet powerful, seeds can provide a variety of vital nutrients, including vitamins, fiber, protein, and iron, which can support a healthy lifestyle and aid in the body's defense against illness. According to studies, seeds contain a variety of phyto-compounds that, at certain critical levels, have strong anti-nutritional effects in addition to nutritionally significant bio-compounds (Kumar *et.al.*, 2006).

The Combretaceae family includes the flowering evergreen *Terminalia chebula* (*T. chebula*). *Terminalia chebula* is commonly referred to as "Horitoki" in Bangladesh. The trees can reach a height of roughly

2000 meters above sea level. The mountainous regions of Bangladesh, India, Nepal, Sri Lanka, Myanmar, Iran, Egypt, and Turkey are home to this tree.

Despite having a variety of phytoconstituents, including tannins, flavonoids, sterols, amino acids, fructose, resin, fixed oils, and more, *Terminalia chebula* is relatively enriched in various tannins (about 32% of its tannin content). The geographic location of *Terminalia chebula* has a significant impact on its tannin content (Aneja *et.al.*, 2009). Chebulic acid, chebulinic acid, gallic acid, corilagin, and ellagic acid are the main constituents of tannin.

"King of Medicine" is the name given to *Terminalia chebula*. According to Ayurvedic Materia Medica, it is a highly recommended plant for the treatment of gout, vomiting, sore throats, bleeding piles, and asthma. Thai

traditional medicine uses it as an expectorant, astringent, and carminative (Panuto *et.al.*, 2011). A herbal preparation of "three fruits" from the plants *Terminalia chebula*, *Terminalia bellirica*, and *Terminalia officinalis*, known as "triphala," is used as a laxative for chronic constipation, a colon detoxifier, a remedy for food digestion issues (poor digestion and assimilation), and a body rejuvenator (Prasad *et.al.*, 2006). Triphala is used as a cardiogenic for candid infection and is thought to be the most adaptable of all herbal preparations (Kaur *et.al.*, 2005).

For therapeutic purposes, Horitoki fruit is utilized both internally and externally. Fruit paste efficiently lowers swelling, speeds up healing, and cleans wounds and ulcers on the outside. Horitoki stops pus from accumulating in erysipelas and other skin conditions. Horitoki oil is very beneficial for wound healing, particularly burns (Usha *et.al.*, 2007).

Because fruit paste has anti-inflammatory properties, it is also used to treat conjunctivitis. Gargles made with its decoction are quite effective in treating stomatitis and throat issues. Externally, triphala can be used to wash hair, brush teeth in cases of pyorrhea or bleeding gums, and its decoction can be used to wash ulcers and chronic, non-healing wounds. To strengthen the gums, horitoki is ground into a fine powder and used as tooth powder. Anticaries include *Terminalia chebula* aqueous extract, which is used as a mouthwash (Haydar *et.al.*, 2011).

Plant-derived chemicals known as phytochemicals are secondary metabolic substances that are not edible and that are found in various plant components. The human body needs them to maintain life since they are vital as anti-disease and protective substances that aid in the body's defense against illness. Their widespread application in traditional medicine is based on their therapeutic use in the prevention or treatment of many ailments. Certain phytochemicals are soluble in water, while others are not (Haydar *et.al.*, 2011).

Determining the proximate composition, phytochemical screening, and mineral content of *Terminalia chebula* seeds was the goal of the current study.

2. MATERIALS AND METHODS

2.1. Collection of sample

In April 2016, fully grown fresh *Terminalia chebula* seeds were gathered from the Rajshahi district of Bangladesh. The taxonomist at the Bangladesh National Herbarium in Dhaka, where a voucher specimen (No. =4390) has been lodged, identified the seeds.

2.2. Preparation of sample

Dirt was removed from the ripe seeds by washing them. After that, seed material were oven-dried at a lower temperature (< 45°C). Then the material turned to powder form by grinding. Powdered material passed through 20-

mesh screen powder was subsequently marked for future use and kept in an airtight container.

2.3. *Terminalia chebula* seed's Proximate analysis

2.3.1. Moisture and Dry matter content Determination

Powder sample (five gram) were taken to a petri dish that had already been weighed, and they were dried for six hours at 110°C to maintain their weight. Before being weighed, the oven-dried petri dish was taken out of the oven and allowed to cool in a desiccator. The petri dish was taken out of the desiccators and weighed after 30 minutes. Until a steady weight was achieved, this heating and cooling procedure was repeated. The mean values of the triple measurements were used to calculate the samples' moisture content based on their ultimate weight.

$$\% \text{ moisture} = \frac{\text{initial weight (before drying)} - \text{final weight (after drying)}}{\text{Initial weight (before drying)}} \times 100$$

$$\% \text{ dry matter} = 100 - \% \text{ moisture}$$

2.3.2. Organic matter and Ash content Determination

After being cleaned and dried for 30 minutes at 180°C in an oven, the crucible was cooled and weighed (W_1). The crucible was filled with three grams of sample and weighed (W_2). It was then moved into a muffle furnace that was set to 650°C and left there for three hours, or until the contents turned white. The crucible was then cooled in a desiccator and weighed again (W_3). The following relation was then used to get the % ash content:

$$\text{Ash (\%)} = \frac{\text{weight of ash}}{\text{weight of sample}} \times 100 = \frac{W_3 - W_2}{W_2 - W_1} \times 100.$$

$$\text{Organic matter (in Percentage)} = 100 - \text{ash\%}$$

2.3.3 Acid Insoluble and soluble ash Determination

0.5 grams ash sample has been combined with 25 milliliters of diluted hydrochloric acid, which was then gently heated for five minutes. After gathering the insoluble material on ash-free filter paper, it was cleaned with distilled water and allowed to dry. After an hour of ignition, it was cooled in a desiccator and weighed. igniting repeatedly until steady result is achieved.

$$\text{Acid insoluble ash (\%)} = \frac{(\text{weight of ash taken} - \text{weight from ash, acid insoluble})}{\text{weight of ash taken}} \times 100$$

$$\text{Acid soluble ash (in Percentage)} = 100 - \text{ash, acid insoluble \%}$$

2.3.4 Water Insoluble and soluble ash Determination

After carefully combining 1 gram of ash sample with 25 milliliters of purified water, the mixture was gently heated for five minutes. After gathering the insoluble material on ash-free filter paper, it was cleaned with hot distilled water and allowed to dry. then chilled in desiccators, weighed, and ignited for 15 minutes at a temperature of no more than 450°C. igniting repeatedly until a steady value is achieved.

$$\text{Water insoluble ash (\%)} = \frac{(\text{weight of ash taken} - \text{weight of water insoluble ash})}{\text{weight of ash taken}} \times 100$$

$$\text{Water soluble ash (\%)} = 100 - \text{acid insoluble ash\%}$$

2.3.5 Analysis of Nitrogen content

Nitrogen content was identified as total nitrogen in Kjeldahl method. A macro Kjeldahl flask was filled with two grams of the material and twenty milliliters of distilled water. To stop the flask from foaming, it was swirled for a few minutes and then left for half an hour. An automated pipette was also used to administer 50 cc of concentrated H_2SO_4 . The flask was carefully heated on the digesting stand to a low temperature of $45^\circ C$. After removing the water and stopping the foaming, the flask's temperature was raised until the digest was gone. For five hours, the digest was cooked. The H_2SO_4 condenser was positioned around halfway up the flask's neck thanks to controlled heating during boiling. After letting the flask cool, 50 milliliters of distilled water was added. A macro Kjeldahl flask was gently filled with 10 ml of the aliquot. A 50 ml Erlemmeyer flask was filled with 20 ml of H_3BO_3 indicator solution and set beneath the distillation apparatus's condenser. Distillation was started when 20 milliliters from 40% NaOH were introduced to macro Kjeldahl flask using a funnel on stop cork.

Heat has been controlled to reduce frothing and avoid suck back, and at $300^\circ C$, the condenser was kept cool to allow enough cold water to receive through. Distillation was halted when 40 milliliters of distillate were gathered. Titrating with 0.1N standard H_2SO_4 using a burette graded at 0.1 ml intervals allowed for the determination of NH_4-N in the distillate. At the end, the color turned from green to pink. The following formula was used to determine the sample's nitrogen percentage:

$$\text{Nitrogen (\%)} = \frac{0.14 \times (V_1 - V_0) \times N}{P}$$

Here,

V_0 = Blank determination (volume of 0.1 N H_2SO_4 in ml)

V_1 = sample determination (volume of 0.1 N H_2SO_4 in ml)

N = strength of H_2SO_4 .

P = weight of sample in gm.

2.3.6 Protein content Determination

Total Kjeldahl Nitrogen was multiplied with a conversion factor, which is 6.25 (AOAC, 2005) to get protein content from the seed sample.

$$\text{Crude Protein (\%)} = \% N \times 6.25$$

2.3.7. Crude fiber Determination

Powder sample (Five gram) were put into crucibles that had been cleaned and fitted. The reagent system was preheated, and 200 milliliters of 0.255M H_2SO_4 were added to avoid foaming. Using a suction pump, the contents of beaker were filtered through a funnel (Buchner) after being cooked for 30 minutes. Until the residues were free of acid, they were cleaned with hot deionized water. A 500 ml beaker was carefully filled with the remnants that remained after acid digestion.

The material was mixed with 200 milliliters of 0.313M NaOH solution. A Buchner funnel along with 15 cm diameter Whatman filter paper (No. 4) were used to filter

the beaker's contents after it had cooled. To get rid of the alkali, the residue was repeatedly cleaned with hot water also with methylated spirit. After three acetone washes, the leftovers were carefully placed in porcelain crucibles and allowed to dry for two hours at $110^\circ C$. Before being weighed, they were left to cool in desiccators (AOAC, 2000).

$$\text{Crude fiber (\%)} = \frac{\text{mass of dried fiber} \times 100}{\text{mass of sample used}}$$

2.3.8 Carbohydrate contents Determination

The accessible carbohydrate content is calculated by deducting the total of protein, ash, crude fiber, moisture, fat, values (per hundred grams).

Therefore, the content of carbohydrates is equal to 100 minus the percentage of moisture in dry seeds, ash, protein, crude fiber, and fat.

2.3.9 Food energy Estimation

Energy value (kcal) of present samples was calculated by multiplying the percentage of crude protein, fat, and carbohydrate by the recommended factor (4, 9, and 4 respectively) used in vegetable and seed analysis (Sofowora *et.al.*, 2008).

2.4. Terminalia chebula's seed Phytochemical Content

The technique of tracking down plant materials is called phytochemical screening. It verifies the existence of a number of phytochemicals that may one day be used to make beneficial medications. Typical phytochemical techniques were used to identify the presence of various kinds of components, such as flavonoids, alkaloids, and saponins, in *Terminalia chebula* seeds (Akinyemi *et.al.*, 2016).

2.5. AAS technique for Elemental analysis

For the determination of element content, the mineralized sample was used in varying volumes. Here, K and Na was calculated with the help of AnA-135, OSK, Japan, flame photometer. For flame and graphite furnace, Varian, AA240FS, Australia, Atomic Absorption Spectrophotometer was used to analyze the majority of the elements found in the seeds of our plant samples, including Ca, Mg, Cr, Fe, Zn, Al, Cu, Ni, Pb, Cd & Mn. Air acetylene flame mode is the one we have selected for our experiment. In case to maintain inert atmosphere with the argon gas flow, the air flow rate was 15 l/minute and the fixed acetylene flow rate was 1.8 l/minute. Every element analysis was conducted with the instrumental default temperature values automatically set.

RESULTS AND DISCUSSION

3.1. Calorific value Proximate analysis

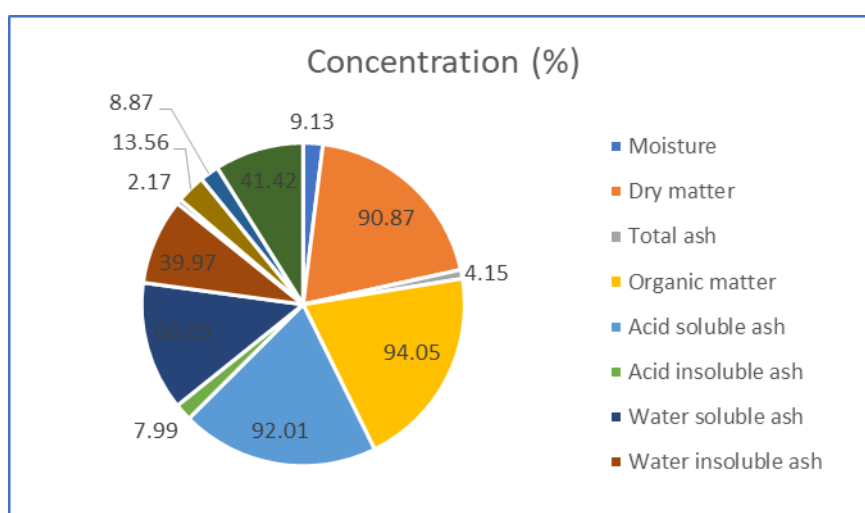
Terminalia chebula seed's percentages of different nutrients were determined by the proximate analysis. The findings of *Terminalia chebula*'s seed proximate composition and calorific values are shown in following Table 1.

Table no. 1: *Terminalia chebula*'s seed Proximate composition (%) and energy value (cal/g).

Parameters	Concentration (in percentage)
Moisture	9.13
Dry matter	90.87
Total ash	4.15
Organic matter	94.05
Acid soluble ash	92.01
Acid insoluble ash	7.99
Water soluble ash	60.03
Water insoluble ash	39.97
Nitrogen content	2.17
Protein content	13.56
Crude fiber	8.87
Carbohydrate contents	41.42
Food energy	269.06 cal/gm

The dry matter and moisture percentages were 90.87% and 9.13% respectively. When it comes to food processing, preservation, and storage, moisture content is one of the most important considerations (Akpabio *et.al.*, 2013). The low moisture percentage found suggests that *Terminalia chebula* seeds have a short shelf life, meaning that prolonged storage may cause spoiling

because of their vulnerability to microbial attack (Sagarika *et.al.*, 2000). Ash content provides an indication of the quantity of mineral elements in the seed and is helpful in evaluating the quality grading of seeds, 94.05% of the material was organic matter, and 4.15% was ash.

**Figure 1: *Terminalia chebula* seeds proximate composition (%)**

When assessing the drug's purity—that is, whether it contains foreign organic materials like silica or metallic salts—the total ash is very crucial (Musa *et.al.*, 2006). From the total ash content, the amounts of the acid soluble ash was (92.01%), insoluble ash (7.99%), whereas the amounts of water soluble ash (60.03%), insoluble ash (30.97%) was determined in the current study. The amount of lignin and non-digestible carbohydrates in *Terminalia chebula* seeds is shown by the crude fiber (8.87%) found in this study (Shahin *et.al.*, 2012).

Although fiber has little to no nutritional value, it may help prevent diabetes and lower high blood cholesterol levels due to its effects on the digestive tract (Shahin *et.al.*, 2012). Because large levels of crude fiber might irritate the intestines, reduce digestibility, and reduce

nutrient utilization, low levels are thought to be suitable (Shamsun *et.al.*, 2012).

One important source of energy is proteins. Essential amino acids found in it are in charge of human tissue growth and repair²⁰. The seed sample was found to have 2.17% nitrogen and 13.56% protein. For seed proteins to be successfully used in a variety of food products, they must have the necessary functionality. Known as functional properties, these inherent physio-chemical characteristics impact how attributes behave into the food systems throughout the processing, manufacturing, storage, and the preparation (Jimoh *et.al.*, 2019); (Aremu *et.al.*, 2007).

The body uses carbohydrates as a convenient source of energy (Shamsun *et.al.*, 2014). 41.42% of the seed is

made up of carbohydrates. The seed has 269.06 cal/gm of food energy. This large calorific values discovered suggested, the studied plant seed could provide a substantial energy source for a sizable portion of the world's poor and disadvantaged population (Shamsun *et.al.*, 2013).

3.2. Phytochemical content

Terminalia chebula seed contains flavonoids, alkaloids, and saponins, as shown in Figure 1. Although alkaloids are frequently harmful to human and can have the dramatic physiological activities, the high percentage of saponins (51.89%) and alkaloids (28.46%) in *Terminalia chebula* seed indicates that it may be utilized as medication (Shahin *et.al.*, 2016). Plants manufacture saponins, a class of compounds having detergent-like

qualities, to help fend off microbial infections. Alkaloids and saponins lower the risk of cardiovascular conditions like hypertension by preventing excessive intestinal absorption of cholesterol (Shahin *et.al.*, 2015).

Strong experimental evidence of flavonoids' innate capacity to alter the body's response to allergens, viruses, and carcinogens has led to their designation as nature's biological response modifiers. In this investigation, a flavonoid content of 10.40% was obtained. A class of polyphenolic chemicals known as flavonoids has anti-inflammatory, hydrolytic, and oxidative enzyme inhibition, as well as the ability to scavenge free radicals (Shamsun *et.al.*, 2015). The plant's potential for industrial and medicinal applications is suggested by their secondary metabolites.

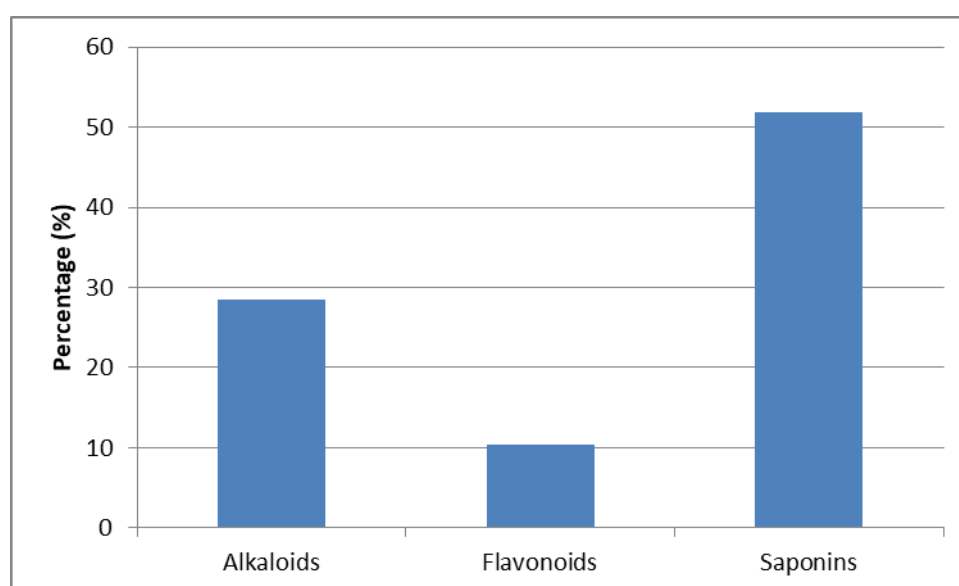


Figure 2: Phytochemical composition (%) of *Terminalia chebula*'s seed.

3.3. Elemental analysis

Table 2 displays the mineral composition finding. With a value of 106.82 mg/g, potassium is the most prevalent mineral in the sample. A high potassium level in the

body has been shown to improve iron utilization and help those who take diuretics to regulate their hypertension and have excessive potassium excretion in bodily fluids (Shahin *et.al.*, 2016).

Table no 2: *Terminalia chebul*'s seed mineral composition.

No.	Element name	Content (mg/g)
1.	K	106.82
2.	Ca	17.92
3.	Mg	7.42
4.	Na	19.09
5.	Zn	0.33
6.	Fe	0.68
7.	Al	0.50
8.	Mn	0.031
9.	Cu	0.052
10.	Ni	0.003
11.	Pb	0.003
12.	Cr	0.001
13.	Cd	0.0001

Sodium is second most prevalent component with a value of 19.09 mg/g, in current study. It aids in healthy operation for muscles and nerves and controls the body's fluid equilibrium (Richard *et.al.*, 2007). Nonetheless, this sample should be carefully taken into account,

particularly when following a diet low in sodium and potassium. Given that high dietary salt is linked to renal and cardiovascular diseases, this is crucial (Akinpelu *et.al.*, 2006).

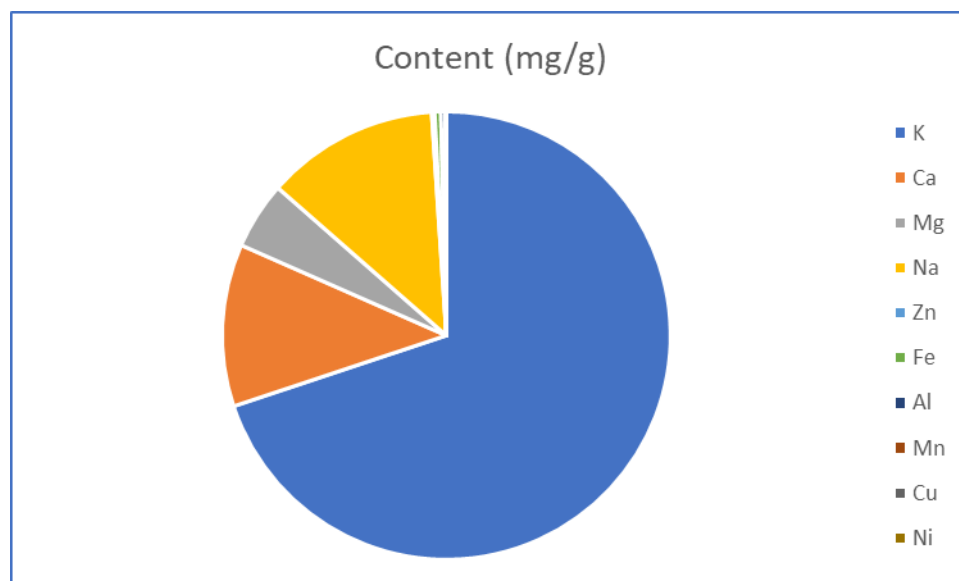


Figure 3: *Terminalia chebula* seeds mineral composition.

As a component of bones, calcium aids in proper body contraction, blood coagulation, and nerve communication (Adeyeye *et.al.*, 2002). The calcium content of *Terminalia chebula* seeds was 17.92 mg/g. The sample of *Terminalia chebula* seeds contained magnesium at levels of 7.42 mg/g and 20.67 mg/kg, respectively. Magnesium lowers blood pressure and reduces the risk of stroke, cardiac arrest, and unexpected heart attacks. A lack of magnesium causes muscles to twist uncontrollably, which can cause convulsions and ultimately death.^[33]

The seed has 0.68 mg/g iron & 0.33 mg/g of zinc. Blood production and the movement of carbon dioxide and oxygen across tissues are both aided by iron (Aletor *et.al.*, 1995). Zinc improves the health of our hair, aids in the proper operation of some sense organs, including taste and smell (Aliyu *et.al.*, 2008) aids in the metabolism of proteins and carbohydrates, aids in vitamin A metabolism of its storage location in livers, as well as makes it easier to synthesize DNA and RNA, which are essential for cell production.

The sample contains 0.50, 0.031, and 0.052 mg/g of copper, manganese, and aluminum, respectively. Lead, nickel, and chromium concentrations were also determined to be 0.003, 0.003, and 0.001 milligram/kg, respectively. Cadmium, the least abundant mineral element in the sample, was found to be present at 0.0001 mg/kg.

4. CONCLUSION

The medical field has greatly benefited from the use of plants. The majority of medications used to treat infections have come from it. *Terminalia chebula*'s proximate and phytochemical compositions indicate that the seeds contain essential components required to fight off a variety of human illnesses. Seeds' high mineral content makes them suitable for human consumption, animal feed, and as raw materials for the production of medications. Further investigation would be carried out regarding the chemical makeup and potential separation for the sake of standardizing the formulation for efficient drug use, of the active components for specific applications.

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Conflict of Interest

There is no conflict of interest.

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