



Nutritional and Medicinal Potential of Bottle Gourd (*Lagenaria siceraria*): A Mini Review

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BOTTLE Gourd (*Lagenaria siceraria*) has prevalent use as a vegetable in different parts of the world. It is an extremely advantageous resource because it comprises lots of nutritional properties required for nourishment and necessary for health. Approximately, it contains: (moisture, protein, fat, carbohydrate, fibre, ash, and energy of 94.5 ± 0.06 ; 1.2 ± 0.06 ; 0.2 ± 0.02 ; 3.75 ± 0.03 ; 0.7 ± 0.01 ; 0.5 ± 0.01 ; 15 ± 0.12 %), respectively. In addition, bottle gourd is rich in minerals like calcium, phosphorous and also have a good source of dietary fibres. Recently, the attention on bottle gourd has been increasing as a nutritional element/health supplement in the diet due to its function in the prevention and control of the diseases like indigestion, ulcers, stress, depression, and premature greying of hairs. In spite of this, bottle gourd also acts as a remedy for diseases like insanity, epilepsy, and nervous disorders and the fibres present in it are helpful in reduction of coronary heart diseases and diabetic occurrence. It contains high choline levels, metabolic/metabolites precursors desirable for the functions of the brain, as well as amino acids, vitamins, and minerals that help in synthesising neurotransmitters. In this review, an insight is presented on the effective properties, health-related, and other significance of bottle gourd in various food products as well as in pharmacological products.

Keywords: Bottle Gourd, Medicine, Nutrition, Processing.

Introduction

Bottle Gourd (*Lagenaria siceraria*) is a strenuous vine having big leaves and belongs to the *Cucurbitaceae* group or distinguished as Calabash, Doodhi, and Lauki in various regions in India (Deore et al., 2009). It is also known outside India in different countries where it is known as courage bouteille in France; cojombro and cuiro amargo in Spain; upo, talayag, gucuzzi, and zucca melon in Philippines and mokwa and oo lo kwa in China (Gajera et al., 2017). The countries that produce bottle gourds are Sri Lanka, Malaysia, South Africa, Indonesia, and India. The plant can grow on the ground like a pumpkin vine, and it is a herbaceous plant with branches in nature of their growth. Their stems are covered with short soft hair known as downy. The leaves are alternately arranged, and tendrils are also consistently found.

The roots are smooth and circular in shape and white or pale cream. The taproot goes through up to a distance of 80cm downward, but most of the roots spread out and occupy the upper soil.

Bottle gourd has both male and female flowers known as monoclines found on different sections of a vine; because of that, higher cross-pollination occurs. The fruits' initial colour is green and pale brown at the ripening stage and after senescence. There are various types of bottle gourd shapes that belong to the different kind of genre having various shapes and sized fruit, narrow neck, elongated, and round. The seeds are flat, approximately rectangular, or trapezoidal, whitish to dark brown at the ends. Generally, fruit length depends on its variety and varies from 150 to 1000mm. The overall ingredients of the fruit are essential for the better and healthier lives of human beings. The

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fruits are mainly sweet (for vegetables) and bitter (for medicinal use). Still, botanically, both are from the same family, and formerly in Sanskrit synonym, they are known as the Alaba and Tumbi.

Nonetheless, Due to the difficulty obtaining wild (bitter) variety, recently, the sweet or edible type of bottle gourd has been applied in the wild for medicinal purposes (Das et al., 2017). Moreover, it is recommended to utilise sustainable and innovative technologies for better productivity (Ahmad, 2021). Also, it can be classified into fruit, flower, leaves and seed, as shown in Fig. 1.

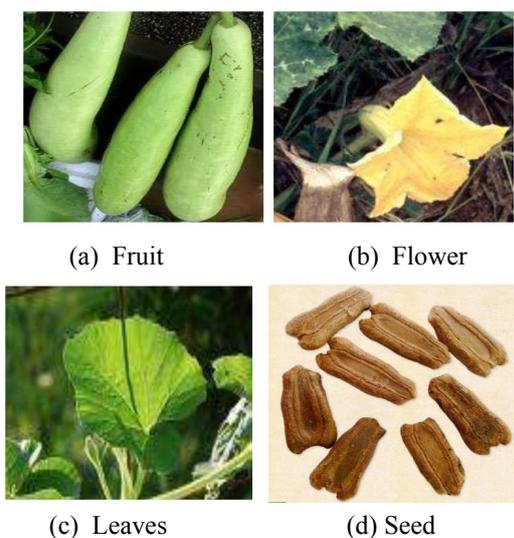


Fig. 1. Different components of bottle gourd

Composition and nutritional value

The bottle gourd contains moisture, protein, fat, carbohydrate, fibre, ash, and energy (94.5 ± 0.06 , 1.2 ± 0.06 , 0.2 ± 0.02 , 3.75 ± 0.03 , 0.7 ± 0.01 , 0.5 ± 0.01 , and 15 ± 0.12 dry wt%), respectively. (Chung et al., 2000). The bottle gourds' edible part has niacin, ascorbic acid, potassium, calcium, and phosphorus of 0.3, 12, 87, 12, and 37 mg, respectively, per 100g of fruit (Sawate et al., 2009). Potassium is available in high amounts after phosphorus and calcium (Hanif et al., 2006). It also contains cucurbitacins, polyphenols, fibres, and two types of sterols (sitosterol and campesterol) (Ghule et al., 2013). The nutritional fibre content in the bottle gourd varieties is beneficial for avoiding gastric disorders like stultification and piles. Also, fibre consumption is helpful in the decrease of coronary heart sicknesses and diabetes occurrence (Hassan et al., 2008). It makes the diet very good due to having an appropriate quantity of vitamins and minerals. Bottle gourds with and without peel contain 11.87

and 2.33mg of iron per 100g, respectively (Milind & Satbir, 2011).

Properties of bottle gourd seed

The bottle gourd's seeds comprise various Phytochemicals, vitamins and minerals, amino acids, and omega fatty acids. If the seeds are properly utilised, they are useful in overcoming malnutrition problems in underdeveloped countries and can be used in agro-based industries as raw materials (Deshpande et al., 2007, Hassan et al., 2008). The seed kernel generally contains the percentage of moisture, protein, fat, carbohydrate, ash, and fibre of 2.47, 30.72, 52.54, 8.3, 4.43, and 1.58%, respectively (Hemeda & Khattab, 2010). The oil derived from the seeds is pale yellow and is frequently used in hair treatment (Kubde et al., 2010; Wang & Ng, 2000).

Properties of bottle gourd peel

The bottle gourd peels are proficient in various minerals and antioxidants. Many researchers studied the composition of bottle gourd peels (Bhat et al., 2017). The raw, steamed, or boiled peel of bottle gourd has high calcium and iron, about 12.5 and 11.25mg, respectively, and phosphorus content is higher than in the whole bottle gourd fruit. Bottle gourd's skin has the highest (84.86%) scavenging activity compared to whole and pulp (20.73%).

Medicinal and health benefits of bottle gourd

Bottle gourd, mainly in Asia, is also used as herbal medicine for a prolonged time (Schlumbaum & Vadorpe, 2012). Its juice has helped cure acidity, indigestion, and ulcers. It is also used as a remedy for pain, fever, pectoral cough, asthma, and other bronchial disorders (Deore et al., 2009). This vegetable has been conventionally utilised for medicinal purposes like cardiotoxic, cardioprotective, aphrodisiac, diuretic, and antidote to certain poisons (Deshpande et al., 2008). It is also significant to give benefit in nervous diseases, insanity, and epilepsy. It has anti-hyperlipidemic activity (Mohale et al., 2008). One glass of bottle gourd juice consumption daily helps preventing early greying of hairs (Hemeda & Khattab, 2010).

Bottle gourd is used as a vegetable to give good health and treat mental health disorders (Rahman, 2003). Moreover, only bottle gourd encompasses the highest choline level and appropriate metabolic precursors for brain functioning among all cucurbits families. Therefore, the bottle gourd has good therapeutic importance and is recommended to be consumed in daily diet for nutrition. Deshpande

and co-workers studied that earthquake victims in Gujarat; 35 persons had mental problems like dysthymia, stress, and neurotic disorders. Capsules prepared from shade dried bottle gourd are used for the treatment of these victims, and significant results were obtained in improving their fitness by reducing depression and mental stress since bottle gourd fruits are a good source of bioactive compounds that may be used as chemical defences against infection or predation (Deshpande et al., 2008).

Pharmacological properties

Plants are major sources for natural products and plant-based medicaments are the basis of many of the modern pharmaceuticals (Mohamed & Sorour, 2020; Behera et al., 2021). The selection of the right scientific technique and systemised approach to the biological analysis of plant products, based on their utilisation in traditional medicines, is the perfect development of new plant-originated drugs. One such product is *Lagenaria siceraria* which possesses excellent pharmacological properties that can be used to treat different diseases. Some of the properties are elaborated in the subsequent sections.

Anti-hyperlipidemic property

The administration of the aqueous extract of bottle gourd orally reduced the elevated levels of triglycerides, cholesterol, and low-density lipoprotein while enhancing the high-density lipoprotein levels. The dietary fibre present in the fruit lowers the cholesterol level. Saponins in this fruit increase lipoprotein activity and rapidly remove fatty acids in the blood (Aslam & Nijam, 2013).

Anti-inflammatory and analgesic characteristics

Ghule and co-workers showed the anti-inflammatory and analgesic effects of bottle gourd juice extract in mice and rats. They studied its analgesic property on acetic acid-induced writhing and formalin pain tests on mice. The anti-inflammatory effects were investigated using acute inflammatory models, i.e., ethyl phenyl propionate induced ear edema, carrageenan, arachidonic acid-induced hind paw edema, and the albumin-induced paw edema in rats. The activity was due to the presence of flavonoids (Ghule et al., 2006).

Diuretic property

Diuretic activity of *Lagenaria siceraria* fruit was assessed by measuring different parameters, i.e., total urine volume, urine concentration of sodium, potassium, and chloride. It was found that the extracts of *Lagenaria siceraria* fruit (100-200mg

kg⁻¹, p.o.) showed higher urine volume and exhibited dose-dependent increase in excretion of electrolytes (Ghule et al., 2007).

Antioxidant property

Acetone extract of fruit epicarp of *Lagenaria siceraria* fruit showed maximum antioxidant activity in-vitro model using DPPH. The fresh juice of the fruit also showed free radical scavenging activity (Deshpande et al., 2007). The fruit extract was also effective in CCl₄ induced liver damage, where it maintained the level of endogenous antioxidant enzymes (superoxide dismutase, catalase and glutathione peroxidase) and marker of lipid peroxidation to normal (Fard et al., 2008).

Immunomodulatory property

When extracted with methanol, bottle gourd fruit showed notable reactions in rats, increasing white cells and lymphocytes. HPLC analysis showed the presence of lagenin (a ribosome-inactivating protein), which is responsible for the activity. Bottle gourd was evaluated for its immunomodulatory activity against pyrogallol induced immunosuppression. The results showed an increase in humoral and cellular immunity. The increase in non-specific immunity is indicated by the subsequent rise in the total leucocyte and neutrophils count. The studies made it clear that the fruit has both specific and non-specific immunity modulating activity (Mehta et al., 2011).

Hepato and cardioprotective property

The extract was prepared using soxhlet extraction using petroleum ether and methanol, and it was found that the methanolic extract exhibited the highest mortality (100%) within 96 hours with IC₅₀ 35.6ppm (Elhadi et al., 2013). The fruit powder of *Lagenaria siceraria* showed good cardioprotective effects. The drug was studied against Doxorubicin induced cardiotoxicity in rats at 200mg/kg, p.o. for 18 days. The *Lagenaria siceraria* prevented the alteration in endogenous antioxidants (superoxide dismutase, reduced glutathione) and lipid peroxidation, whereas markers of cardiotoxicity i.e., CK, MB, and LDH were significantly reduced. Further, the *Lagenaria siceraria* powder also showed protection against changes in ECG and histopathological alterations induced by doxorubicin. Ethanolic extract of *Lagenaria siceraria* fruits also showed the increased force of contraction and decreased rate of contraction (from 66 to 44) in isolated frog hearts, when perfused with normal ringer solution (Sankari et al., 2010).

Anthelmintic property

The ethanolic extracts of the seeds of *Cucumis sativus*, *Cucurbita maxima* and *Lagenaria siceraria* exhibited potent anthelmintic activity against tapeworms, which was comparable to the effect of piperazine citrate. Some activities against pinworms were demonstrated by seeds of *Cucurbita maxima* (Elisha et al., 1987).

Processing potential of bottle gourd

Bottle gourd is mainly utilised as fruit. It is also a good source of nutrients at a low cost and a good source of naturally available antioxidants and mineral content of *Lagenaria siceraria*, as shown in Table 1. It is composed of vitamin C and choline in appropriate quantities and is a good source of the vitamin B complex. By choosing modern and innovative processing techniques after harvesting fresh bottle gourd fruit, a considerable number of fruits that were getting wasted can be preserved. An adequate processing procedure must be applied for preserving this perishable fruit, but also it is nutritionally important by increasing its shelf-life, whether in fresh or in processed condition (Gajera et al., 2017).

Canning of bottle gourd pulp (BGP)

The quality rating of (BGP) processed by canning was conducted on the different biochemical properties, such as protein and moisture content, pH, titratable acidity, crude fibre, and total soluble solids at an interval of 45 days (i.e., 0, 45 and 90 days) (Patel & Gajera, 2019).

i. The pulp shelf life can be increased up to 90 days without using preservatives and various levels of space provided from the top (10, 20, and 30mm).

ii. Initially, values of various quality parameters of pulp like pH, crude fibre, moisture, and protein content were reduced, but only titratable acidity after canning of (BGP) was increased.

iii. Based on these variables of canned (BGP), the highest retention of protein content, crude fibre, and lowest value of titratable acidity were 0.629, 0.229 and 0.163%, respectively, were carried in treatment P7 (S3H1) (0.10% benzoic acid + 10mm space) after the treatments and storage up to 90 days.

TABLE 1. Nutritional value of bottle gourd (Gopalan et al., 1971; Rahman, 2003)

Nutrients	Fruit (mg)	Seed (mg)
Proximates		
Protein	620	24540
Total Lipids (Fat)	20	45850
Carbohydrate	3390	17810
Fiber	--	3900
Minerals		
Calcium	26	43
Iron	0.20	14.97
Magnesium	11	535
Phosphorus	13	1174
Potassium	150	807
Sodium	2	18
Zinc	0.026	7.46
Copper	0.066	1.39
Manganese	0.2	3.02
Vitamins		
Ascorbic Acid	10.1	1.9
Thiamin	0.029	0.21
Riboflavin	0.022	0.32
Niacin	0.32	1.745
Pantothenic acid	0.152	0.339
Vitamin B-6	0.04	0.224
Choline	16.02	--
Amino acids		
Tryptophan	3	431
Threonine	18	903
Isoleucine	33	1264
Leucine	36	2079
Lysine	21	1833
Methionine	4	551
Cystine	--	301
Phenylalanine	15	1222
Tyrosine	--	1019
Valine	27	1972
Arginine	14	4033
Histidine	4	681
Alanine	--	1158
Aspartic acid	--	2477
Glutamic acid	--	4315
Glycine	--	1796
Proline	--	996
Serine	--	1148

iv. Microbial analysis of (BGP) based on *E. coli*, *salmonella*, and total plate count (TPC) and resulted in no microbial contamination or growth found in any sample of different treatments at the

storage of 90 days.

Application of bottle gourd in food products

Bottle gourd takes the lead in the diet compared to other vegetables grown in India since it is a nutrient-dense and low-cost source. Non-bitter bottle gourd is used for eating (Sivaraj & Pandravada, 2005). Therefore, the preparation of these foods and beverages is mostly restricted to the home (Bhalla, 2007). The various products that can be developed from bottle gourd fruit are pickles, chutney, juice, and sweets (Walters et al., 2004). Bottle gourd candy is prepared by dipping bottle gourd cubes in sugar syrup (Ahmad & Ahmad, 2021). A salt substitute blend and bottle gourd fruit are also used to create high fibre, low salt, and low-fat chicken nuggets (Verma et al., 2012). Bottle gourd halwa is one of the traditional Indian dairy products prepared from grated bottle gourd cooked with sugar, khoa, ghee, and flavoured by spices like cardamom.

Bottle gourd juice

The juice was extracted with the help of a juicer and filtered by using a muslin cloth in two layers. Basil and bottle gourd juice was shown to be preserved for six months and microbiologically safe (Majumdar et al., 2011). Whey-based beverages made with pineapple and bottle gourd juices and extracts from edible medicinal herbs like *Mentha arvensis* have been shown to have outstanding nutritional, therapeutic, preventive, antibacterial, and organoleptic characteristics (Baljeet et al., 2013). The influence of several chemical additions on the shelf life of bottle gourd juice was investigated (Kaur & Aggarwal, 2014).

Bottle gourd sweets and sweetmeat

Suchita and co-workers prepared burfi using different concentrations of bottle gourd pulp, sugar, and khoa. Bottle gourd pulp concentration had a definite effect on enhancing the sensory characteristics such as flavour, texture, and colour and on the overall acceptability of bottle gourd burfi (Suchita et al., 2017). The score concerning the quality of cow milk burfi presented that the burfi prepared by utilising cow milk khoa with 15% bottle gourd pulp has the highest score (8.86) and rated as an utmost acceptable product.

Saini & Sharma (2018) studied that bottle gourd sweetmeat (BGSM) with 30% BGP showing the difference in its ostensible viscosity

when heating is done using a microwave. Replacing khoa using 30% BGP has made it an adequate product to produce by enhancing its sensory characteristics. The low protein and fat amount in BGSM were found significant ($P < 0.05$) more than 10% replacement of khoa-sugar mix with bottle gourd pulp. Under refrigerated conditions, the shelf-life study found the good quality of BGSM after six days of storage.

Bakery and dairy products

Kheer prepared by using bottle gourd cubes and milk is a good dietary source with higher shelf life than kheer prepared by rice and milk (Changade et al., 2012). Kamble and co-workers evaluated the sensory evaluation, chemical composition, and microbial quality of bottle gourd *Pedha*; overall acceptability of product is high, which is prepared by using 5% bottle gourd pulp. They claimed that a healthy, delicious, and low-cost *Pedha* might be made by combining 5% bottle gourd pulp with 95% buffalo milk *Khoa* on a weight-for-weight basis (Kamble et al., 2014).

Sharma and co-workers used 80% wheat flour and 20% bottle gourd pulp fibre to make fibre-rich biscuits (Thakur et al., 2013). The overall acceptability of biscuits prepared by using bottle gourd pulp powder (BGPP) was similar to ordinary wheat biscuits and it was able to decrease the glycaemic response to a similar amount in both healthy users and individuals with diminished glucose tolerance. In addition, Katare & Sharma (2013) expressed a fibre enriched Namkeen Sev, an Indian snack, by integrating dried bottle gourd pulp powder as a basis of fibre.

Companies producing commercialised products of bottle gourd

Immature bottle gourd fruits are utilised in various ways, such as tender fruits being broadly consumed as vegetable sources (Sivaraj & Pandravada, 2005). They are used in curries, and watery flesh is also consumed to make cakes glazes. It is also utilised for making juices, pickles, chutney, and sweets. In India, the most common vegetable curry from bottle gourd fruit is kofta. Some of the Indian company's industrial bottle gourd products are bottle gourd powder, herbals and sarvaayush ayurved, Maharashtra; Amla bottle gourd Juice blend, Yacca Food Products, and Haryana; Taj Frozen Foods Pvt. Ltd. (fresh and frozen vegetable bottle gourd).

Indian varieties of bottle gourd

Kashi Kiran (Vrbg-4)

The Kashi Kiran variety bottle gourd (Fig. 2) has light green attractive round fruits, tolerant to Downey Mildew. Each fruit weights around 600-700g. The number of fruits is 13-14/plant, with the average yield of 45-48t/ha. This variety is recommended for cultivation in Uttar Pradesh and notified vide gazette notification number S.O. 692(E), dated 05.02.2019 (IIVR, 2019).



Fig. 2. Kashi Kiran variety of bottle gourd

Kashi Kundal (Vrbog- 16)

They are attractive pear-shaped green fruits, medium in size (Fig. 3), suitable for sowing from July to September. The number of fruits is 12-14 per plant, with an average fruit weight of 1.3 to 1.5 kg. They are resistant to Downey Mildew. Better yield yield (47.5 t/ha) as compared to the check variety. This variety is recommended for cultivation in Uttar Pradesh and notified vide gazette notification number S.O. 692(E), dated 05.02.2019 (IIVR, 2019).



Fig. 3. Kashi Kundal variety of bottle gourd

Kashi Kirti (Vrbog- 63-02)

The Kashi Kirti (Vrbog- 63-02) has fruits

that are green, small, and have cylindrical shape (Gutka type) (Fig. 4). They are resistant to Downey Mildew. Variety is early maturing and high yielding as compared to the check variety. The fruits are suitable for distant marketing and transportation due to better post-harvest life and are recommended for cultivation in Uttar Pradesh and are notified vide gazette notification number S.O. 692(E), dated 05.02.2019 (IIVR, 2019).



Fig. 4. Kashi Kirti variety of bottle gourd

Kashi Ganga

Kashi Ganga variety of bottle gourd obtained from the cross IC-92465 x DVBG-151. The colour of its fruits is lightly green of about 30cm in length, 7cm in diameter, 7cm and weight in the range of 800-900g and yield of about 80-550 quintal/ha. This variety is resistant to anthracnose, and thus suitable for the rainy and summer season and is cultivated in different states like U.P., Punjab, and Jharkhand (IIVR, 2019) (Fig. 5).



Fig. 5. Kashi Ganga variety of bottle gourd

Hybrid -Kashi Bahar

Hybrid Kashi Bahar variety has long fruit

length about 30-32cm with green vigorous growth and vine, fruits are straight and light green in colour and the average weight in the range of 780-850g and yield 500-550 quintal/ha (Fig. 6). It is appropriate for cultivation in the rainy and summer season because it is resistant to anthracnose, downy mildew, and *Cercospora* leaf spot under field conditions and is cultivated in different states like U.P., Punjab Bihar, and Jharkhand (IIVR, 2019).



Fig. 6. Hybrid Kashi Bahar variety of bottle gourd

Conclusion

The need of the hour is to work on food security, sustainable agriculture, and exploring the health and medicinal benefits of different fruits and vegetables to feed the growing population nutritionally. Bottle gourd is one of the high nutritional and beneficial vegetables gifted by Almighty to human beings. It contains the essential constituents required for good health and well-being and has the potential to resist, prevent, and treat various diseases. Since it possesses extraordinary properties, it can be coined as a natural protector for human beings. It is one of the universal laws of nature that “*The food be thy medicine*”, we can get adequate nutrition from the plants. The study highlights the characterisation and availability of bottle gourd and its processing potential, including the inherent capability to resist infestation. The paper elaborates on the nutritional and pharmacological properties of bottle gourd and its potency in treating various diseases. Bottle gourd has a wide range of uses in different food products like curries, jams, sweets, juices ,etc. Hence, there is a need to develop and promote assorted products from bottle gourd, which can be commercialised in a viable manner and will generate interest among the consumers.

Therefore, it is recommended to include bottle gourd in our daily diet to attain health and well-being.

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الإمكانات الغذائية والطبية لنبات الكالاباش : دراسته مرجعية

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ينتشر نبات الكالاباش (*Lageneria siceraria*) في أجزاء مختلفة من العالم. ويعتبر مصدر مفيد للغاية لأنه يشتمل على الكثير من العناصر الغذائية المطلوبة للتغذية والضرورية للصحة. يحتوي النبات على نسب رطوبة، بروتين، دهون، كربوهيدرات، ألياف، رماد، وطاقة كالتالي: 0.02 ± 0.2 ؛ 0.06 ± 1.2 ؛ 0.06 ± 94.5 ؛ 0.01 ± 0.5 ؛ 0.01 ± 0.7 ؛ 0.03 ± 3.75 ؛ 0.12 ± 15 % ، على التوالي. وبالإضافة إلى ذلك، فإن نبات الكالاباش غني بالعناصر مثل الكالسيوم والفوسفور وهو أيضاً مصدر جيد للألياف الغذائية. وقد زاد الاهتمام في الآونة الأخيرة بنبات الكالاباش كعنصر غذائي / مكمل صحي في النظام الغذائي بسبب دوره في الوقاية من بعض الأمراض والسيطرة عليها مثل عسر الهضم والقرحة والتوتر والاكتئاب وشيب الشعر المبكر. على الرغم من ذلك ، فإن نبات الكالاباش يعمل أيضاً كعلاج لأمراض مثل الجنون والصرع والاضطرابات العصبية كما أن الألياف الموجودة فيه تساعد في الحد من أمراض القلب التاجية وحدوث مرض السكري. يحتوي النبات أيضاً على مستويات عالية من الكولين، والمستقلبات المرغوبة لوظائف الدماغ ، بالإضافة إلى الأحماض الأمينية والفيتامينات والمعادن التي تساعد في تصنيع النواقل العصبية. وفي هذه الدراسات المرجعية ، يتم تقديم نظرة ثاقبة على الخصائص الفعالة، والمتعلقة بالصحة، والأهمية الأخرى لزجاجة القرع في المنتجات الغذائية المختلفة وكذلك في المنتجات الدوائية.