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Processing potential of bottle gourd (*L. siceraria*) Fruits: An overview

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Abstract

Bottle gourd (*Lagenaria siceraria*), a vigorous annual climbing vine with large leaves belongs to Cucurbitaceae family and known as calabash, lauki, white flowered gourd, trumpet gourd, calabassier, courage bouteille, cojombro, guiro amargo, upo, talayag, guczuzi, zucca melon and mokwa, olo kwa. Bottle gourd fruits having the shape of a bottle are yellowish green with whiter pulp. Bottle gourd is one of the cheapest source of nutrients and potential source of natural antioxidants. The fruit is also a good source of vitamin B complex and choline along with fair amounts of vitamin C. Bottle gourd has long been an important component of indigenous herbal medicine, particularly in Asia. The fruits are traditionally used as a nutritive entity having cardioprotective, cardiostimulant, general tonic, diuretic, aphrodisiac, antidote to certain poisons, alternative purgative, and cooling effects. It is also considered to be beneficial in insanity, epilepsy and other nervous diseases. Bottle gourd fruit has higher edible index and lower waste index proves its importance for processing. This review highlights on processing potential of nutritionally rich bottle gourd fruits to preserve it by extending the shelf- life in fresh form or in the processed form.

Keywords: Bottle gourd, Nutrients, Minerals, Antioxidants, Processing

1. Introduction

Bottle gourd (*Langenaria siceraria*), a vigorous annual climbing vine with large leaves belongs to *Cucurbitaceae* family and known as Calabash, Doodhi, and Lauki in different parts of India [1]. The bottle gourd is also known in other places as white flowered gourd, trumpet gourd, calabassier, courage bouteille (French) cojombro, cuiro amargo (Spanish); upo, talayag, guczuzi, zucca melon (Philippines); mokwa, oo lo kwa (China) [2]. India, Sri Lanka, South Africa, Indonesia and Malaysia are the major bottle gourd producing countries in the world. Bottle gourd can be a tree or fence creeper, or it can grow on the ground like most other members of the pumpkin family. It is annual and dies at the end of each growing season. Bottle gourd is an annual herbaceous plant with a prostrate or branching type growth habit. The vine stems are softly pubescent with jointed, gland-tipped hairs. The leaves are alternate and variable, and tendrils are almost always present. The roots are white to pale cream, smooth and circular in cross-section. The taproot can penetrate down up to 80 cm, but the bulk of the root system spreads out and inhabits the topsoil. Flowers of *L. siceraria* are monoecious in nature, where solitary male and female flowers are found on different plant axis of the same plant, thus cross pollination is highly favorable. The fruit is green at first, but becomes pale brown when it ripens and dries out. There are many forms, shapes, and varieties of gourds each producing a different-shaped and sized fruit, from small and round to large some with an elongated, narrow neck. The length of the fruit varies from 150 to 1000 mm depending upon its variety. Bottle gourd fruits having the shape of a bottle are yellowish green with whiter pulp. The seeds of bottle gourd are flat, more or less rectangular to narrow trapezoidal, whitish to dark brown at the distal end. They develop inside the fruit and show great diversity in shape an [3].

2. Processing Potential**2.1 Chemical Composition**

Bottle gourd fruit has higher edible index (94.17 %) and lower waste index (5.83 %) proves its importance for processing [4]. The fruit rich in nutrients and is available at a cheaper rate. Bottle gourd fruit contains about 96% moisture and is rich in vitamins, minerals, antioxidants and dietary fibers. The fruit is also a good source of vitamin B complex and choline along with fair amounts of vitamin C. Bottle gourd contains 1.6% choline on a dry weight basis [5]. Choline is a precursor to acetylcholine, a chemical used to transfer nerve impulses and hence, it is believed to have neurological effects.

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Use of vegetables as nutritional food and their role in human health was studied [6]. Among the vegetables included in daily diet, the bottle gourd was analyzed for its proximate

composition, vitamin and mineral contents as appended in Table 1.

Table 1: Chemical/bio-chemical constituents of bottle gourd (*L. siceraria*) fruit

Proximate composition (dry weight basis g/100g)						
Moisture	Protein	Fats	Carbohydrates	Fiber	Ash	Energy (kCal)
94.5	1.20	0.20	3.75	0.70	0.50	15.0
Macro and micro mineral content (mg/100g)						
Ca	P	Na	K	Cr	Fe	
12.0	37.0	1.7	87.0	0.05	0.80	
Vitamins content (mg/100g)						
Vitamin B ₁ (Thiamine)		Vitamin B ₂ (Riboflavin)		Vitamin B ₅ (Niacin)		Vitamin C (Ascorbic acid)
0.03		0.05		0.30		12.0

Peeled and unpeeled samples of bottle gourd (*L. siceraria*) was analyzed for the carbohydrate, dietary fiber constituents and mineral content [7]. Higher amount of dietary fiber was found in unpeeled one, while carbohydrates were higher in

peeled sample (Tables 2). Minerals such as calcium, phosphorus, iron, zinc and magnesium were higher in unpeeled sample while potassium, copper, sodium and manganese were higher in peeled sample (Tables 3).

Table 2: Carbohydrates and dietary fiber of bottle gourd (*L. siceraria*) fruit

S. No	Attributes (g/100g dry weight basis)	Bottle Gourd	
		With Peel	Without Peel
1	Total sugar	5.87	8.29
2	Reducing sugars	5.22	7.92
3	Non-reducing sugars	0.65	0.29
4	Starch	1.31	1.57
5	Crude fiber	4.45	3.40
6	Neutral Detergent Fiber	22.71	21.16
7	Acid Detergent Fiber	16.26	15.67
8	Hemicelluloses	6.45	5.58
9	Cellulose	16.07	16.40
10	Lignin	0.193	0.167

Table 3: Mineral contents of bottle gourd (*L. siceraria*) fruit

S. No.	Minerals (mg/100g dry weight basis)	Bottle Gourd	
		With Peel	Without Peel
1	Calcium	80.20	52.78
2	Iron	11.87	2.33
3	Phosphorus	240.33	187.33
4	Potassium	3320.00	3356.67
5	Zinc	3.77	3.47
6	Magnesium	162.33	146.33
7	Copper	0.19	0.24
8	Sodium	27.88	36.68
9	Manganese	0.26	0.31

2.2 Medicinal Properties and Uses

Bottle gourd has long been an important component of indigenous herbal medicine, particularly in Asia [8]. The bottle gourd juice has been used to treat acidity, indigestion and ulcers. It cures pain, fever and is used for pectoral-cough, asthma and other bronchial disorders [1]. The fruits are traditionally used as a nutritive entity having cardioprotective, cardiotonic, general tonic, diuretic, aphrodisiac, antidote to certain poisons, alternative purgative, and cooling effects [9]. It is also considered to be beneficial in insanity, epilepsy and other nervous diseases. It has anti-hyperlipidemic activity [10]. A glass of bottle gourd juice taken daily is also considered to prevent premature graying of hair [11]. and can serve as an effective thirst quencher. Immature bottle gourd fruits are consumed in a number of ways. Tender fruits are widely used as vegetable [12]. They are added to curries and moist flesh is also used to make glaze for cakes [8]. The bottle gourds are used for preparing juice, pickles, chutney, and making sweets. Kofta is the most popular vegetable curry preparation in India

[13].

2.3 Health Facts

Bottle gourd as a vegetable for good health and is used as curative for mental health disorders [14]. Among cucurbits, the bottle gourd is the only plant which contains the highest choline level along with required metabolites/metabolic precursor for brain function. It was emphasized that these fruits have high therapeutic values and must be consumed as daily nutrition. He studied 35 Gujarat earthquake victims, suffering from mental disorders like depression, stress and manic disorders. Victims were treated with shade dried gourd powder capsules and result was extremely significant. The bottle gourd fruits are rich potential source of bioactive molecules many of which probably serve as chemical defenses against infection or predation. Various ethanopharmacological applications of bottle gourd (*L. siceraria*) are listed in Table 4.

Table 4: Ethanopharmacological applications of bottle gourd (*Lagenaria siceraria*) fruit

System	Uses
Gastro-intestinal	Adenopathy, Aliuretic, Dropsy, Laxative, Litholytic, Lithontriptric, Purgative
Cardio Vascular system	Dropsy, Diuretic Hydropsy
Central nervous system	Ache (head), emetic, Ache (Tooth), Bilious, convulsion, insanitary, refrigerant
Genito-urinary system	Dropsy, Diuretic, Litholytic, Lithontriptric
Infections	Alexiteric, Alopecia, Sore throat, Boil, Burn, Cancer, Fever, Depurative, refrigerant, Rheumatism, Tetanus, Tumor, wound
Respiratory system	Asthma, cough
Ear, Nose, Throat	Gum, Hoarseness
Immunology	Cancer, Scrofula, Tetanus, Tumor
Skin	Alopecia, Leucoderma, Anasarca, boil, Burn, Depurative, Pimple, wound
Metabolism	Refrigerant
Musculo-skeleton	Pectoral Rheumatism
Poison	Alexiteric, Antidote

Free radical scavenging activity of *L. siceraria* fruit were studied and have recommended 150-200 g juice of bottle gourd to be taken three times a day by the patients of cardiac atherosclerosis, as it possesses radical scavenging activity [15]. The maximum antioxidant activity was observed in the acetone extract of bottle gourd fruit carp. The radical scavenging activity was attributed to the presence of ellagitannins in the acetone extract of epicarp of bottle gourd. The epicarp of the *L. siceraria* can thus be a good source of antioxidants. Anti-hyperlipidemic activity of isolated constituents from the fruits of *L. siceraria* in albino rats was studied [10]. The study exhibited that elevated blood cholesterol, TG, LDL, and decreased HDL which occur in hyperlipidemia, was significantly reduced by the administration of fractions of *L. siceraria* fruit juice. This finding provides some biochemical basis for the use of fruit, fruit juice and fruit extracts. Studying the nutritional and medicinal potential of *L. siceraria*, it was noted that the dietary prebiotics and phytomedicine have made available novel therapeutic possibilities to manage human health [16]. Bottle gourd is a traditional medicine and is reported to have cardio protective, antioxidant, anti-stress, antihyperlipidemic and anti-inflammatory properties. A novel protein, lagenin, isolated is reported to have antitumor, antiviral, antiproliferative and anti-HIV activities.

Nutrient composition and antioxidant activity of raw and processed bottle gourd (*L. siceraria*) varieties was studied assessing the effect of different processing methods and parts of the bottle gourd on antioxidant activities as well as

determining the antioxidants present in different cultivars (organic and conventional), they found no significant difference between the fibre content of organic pulp and skin when compared to conventional pulp and skin [17]. Calcium content of raw, boiled and steamed bottle gourd skin was found high. This may be due to the accumulation of calcium in skin portion. Reviewed bottle gourd fruit as natural gourd and noted that its juice is helpful in constipation, premature graying hair, urinary disorders and insomnia [18]. Bottle gourd has the highest content of choline among all the vegetables known. The choline serves as the precursor of neurotransmitter acetylcholine, which in turn is crucial for retaining and enhancing memory. Furthermore, *L. siceraria* is a vegetable useful in the management of many diseases like cardiac disorders, hepatic diseases and ulcer. Bottle gourd juice helps to regulate blood pressure of hypertensive patients, because of its high potassium content. It helps in losing weight quickly, because of its high dietary fibre and low fat and cholesterol content. Studied bottle gourd as a potential source of anti-hyperlipidemic and other pharmacological agents for its medicinal applications [19], they concluded that the fruit is rich in a number of phytoconstituents, minerals, vitamins, fibre etc. with potent nutraceutical and therapeutic functions. The bottle gourd is proved to be a potential source of prophylactic and can serve as 'medicinal food' particularly in metabolic disorders associated with carbohydrate and lipid metabolisms. The constituents of bottle gourd and its health implications are summarized in Table 5.

Table 5: Constituents of bottle gourd implicated in therapeutic properties

Extract of bottle gourd	Constituent implicated in therapeutic value	Significance of constituent for human health	Reference
Juice	Ellagitannins	Cardiac atherosclerosis.	[15]
	Choline	Neurotransmitter acetylcholine.	[18]
Epicarp	Antioxidant	Hepatoprotective, Antihyperglycemic, Immunomodulatory, Antihyperlipidemic and cardio tonic.	[9]
Dried juice powder	Isolated compound	Blood cholesterol, triglycerides, LDL and HDL.	[10]
Whole fruit	Lignin	Antitumor, antiviral, ant proliferative and anti-HIV activities	[16]
	Phytochemical, Prophylactic	Metabolic disorders associated with carbohydrate and lipid metabolisms.	[19]

3. Conclusions

Bottle gourd is still underutilized fruit in spite of being one of the cheapest source of nutrients and potential source of natural antioxidants. It is good source of vitamin B complex and choline along with fair amounts of vitamin C. By adopting some of the modern technologies for processing of

fresh bottle gourd after harvest, a significant portion of fruits at present that was getting spoilt can be salvaged. Appropriate processing steps should be taken to preserve this perishable but nutritionally important fruit by extending the shelf- life in fresh form or in the processed form.

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