

TWO WONDER BULB VEGETABLES – A REVIEW

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ABSTRACT

Prebiotics are food components that stimulate the growth of probiotic bacteria of gastrointestinal tract of human beings. Probiotics are the good bacteria that provide therapeutic benefits to the human beings. Prebiotics are naturally occurring in vegetables, fruits and grains. Some of the vegetable bulbs like onion and garlic show the presence of oligosaccharide like inulin. There is a increased scope for such prebiotics most of which can be used in daily diet. Keeping in view, this review covers aspects regarding prebiotics present in onion and garlic, important bulbs that regularly used in the diet. The aim of writing this review is to help to take up research work on such bulbs that are part of the human diet for extending the therapeutic benefits.

Keywords: *Bulbs, Garlic, Onion, Therapeutic Benefits, Prebiotics, Probiotics*

I. INTRODUCTION

Prebiotics are generally defined as non-digestible carbohydrates which promote the growth of beneficial lactic acid bacteria in the colon. The term prebiotics was coined by Gibson and Roberfroid [1] [2] explained the prebiotics concept that selectively hydrolysed and fermented by enzymes presents only in probiotic bacteria like bifidobacteria and increase their numbers intern is associated with health and well being of the human gut [3] classified prebiotics as fructooligosaccharides (FOS), galactooligosaccharides (GOS), lactulose and polydextose. Prebiotics also are fermented by natural microflora of the colon to produce short-chain fatty acids (SCHFA) that provide energy to the epithelial cells of the intestine [4] and provide space for the colonization of the probiotic bacteria.

Prebiotics are present naturally in many vegetables, fruits, grains. The two vegetable bulbs such as Onion and Garlic are the world famous spice commodities, used for flavouring the dishes. Besides culinary purposes, these are considered as valuable therapeutic vegetables. India ranks second in area (9.59 lakh ha) and production (163.09 lakh tons) of onion and in case of garlic, also second in area (2.02 Lakh Ha) and production (11.50 Lakh tons), next to China (FAO STAT, 2015). Besides meeting domestic requirements, India exports 13.0 to 15.0 lakh tons of onion worth Rs. 3000 crores (APEDA Website, 2014). Realizing the importance of onion and garlic in the country ICAR established National Research Centre for Onion and Garlic in VIII Plan with its headquarter at Rajgurunagar on 16 June 1998. In order to encourage the use of vegetable bulbs that contain prebiotic that enhance the probiotic bacteria to improve the health of gastrointestinal tract of human beings, this review article has been prepared.

II. SOURCES OF BULB VEGETABLE PREBIOTICS

Bulb vegetables are underground, vertical shoots that have modified leaves that are used as food storage organs by the dormant plants. Most important bulb vegetables are onion and garlic. The bulbs of onions and garlic are good sources of the prebiotic inulin. Onion and garlic contain 2 to 6 per cent and 9 to 16 per cent of inulin respectively [5].

2.1 ONION

The onion probably originated in East Asia. Traces of onion remains were found In Bronze Age dating back to 5000 BC. The ancient Egyptians worshipped it, believing its spherical shape and concentric rings symbolized eternal life [6]. It is one of the important commercial vegetable crops grown in India. The bulb of onion is swollen at the base with green foliage leaves and fleshy scales. Leaves are tubular, waxy, dark green on the aerial part; the leaves are thin at the base, fleshy at inside, accumulate reserve substances in order to form the bulb. Onions show umbrella inflorescence. The hermaphrodite flowers are white. The demand for onion is worldwide. It is used both in raw and mature bulb stage as vegetable and spices [7] [8] scientific classification of onion is given below:

2.1.1 Scientific Classification of Onion [9] Table.1

Kingdom	Plantae
Clade	Angiosperms
Clade	Nonocots
Order	Asparagales
Family	Amayllidaceae
Subfamily	Allioideae
Genus	Allium
Species	<i>A.cepa</i>

2.1.2 Cultivation and Production of Onion

China is the major producer of onion with 226 lakh tonnes followed by India (163.09 lakh tonnes) and united State of America (32.77 lakh tonnes) in the world (APEDA, 2012).Maharashtra (5864.04 lakh tonnes), Madhya Pradesh (2826.02 lakh tonnes), Karnataka (2065.16 thousand tonnes), Bihar are the important onion producing states in India (NHB, 2013) (National Horticulture Board, (india.gov.in/official-website-national-horticulture-board)). They grow in cool season in a wide range of temperatures (optimal temperatures are 13 to 29°C) in sandy loam, alluvial clay soils, friable, fertile soils with optimum pH of 5.8 – 6.5, well supplied with humus and well drained with a high level of organic matter. The land is prepared by giving 5-6 ploughings. Rotten farm yard manure or compost of 25 to 30 cart loads of well rotten FYM or compost applied at the time soil preparation per hectare or 50 kgs of N 25kgs each of PK should be applied. In order to obtain kharif crop, onion cloves are sown in June & for rabi sown in October-November. Cloves of 10 to 12 kgs are required as seeds are required per hectare. In rabi season, yield of onion is around 25-30 tons per hectare, while in kharif season it may be 150 to 250 quintals of yield/ha. Bhima Red (DOGR), ArkaBindu (IIHR, Bangalore), Agrifound Red (NHRDF, Nasik) which are red variety onion suits for all the seasons; Pusa white round and flat (IARI, New Delhi), white variety onion is for rabi season while Early Grano (IARI, New Delhi) was the yellow

variety onion was used as rabi crop.(www.dogr.res.in/index.php?option=com_content&view) (stats-Directorate of Onion and Garlic Research).

2.1.3 NUTRITIONAL VALUE OF ONION PER 100 Gm [10].

Onion is rich in carbohydrate and potassium. It contains 2 to 6 per cent of inulin as dietary fibre.

Table.2

Energy	166KJ
Water	87.11 g
Carbohydrates	9.34 g
Sugars	4.24g
Dietary fibre	1.7g
Protein	1.1g
Fat	0.1g
Thiamine	0.046mg
Riboflavin	0.027mg
Niacin	0.116mg
Pantothenic acid	0.123mg
Vitamin B6	0.12mg
Vitamin C	7.4mg
Calcium	23mg
Iron	21mg
Magnesium	10mg
Manganese	0.129mg
Phosphorus	29mg
Potassium	146mg
Zinc	0.17mg
Flouride	1.1 µg

Onion bulbs contain a good number of phyto chemicals, most of which are hydrocarbons and their derivatives [11]. These include: Dipropyl disulphide (which is used as a flavour compound), Allicin (which has anti diabetic, antihypertensive, antibiotic and antithrombotic activities), diethyl sulphide (which is of insecticidal property), Dimethyl disulphide (which is used as a gas odorant and in chemical synthesis), Mercapto propane or propylmercaptan (which is used as flavour compound).

III. GARLIC

Allium sativum, is called garlic, is a species in the onion genus having a history of 7,000 years with respect to human use. Garlic is native to central Asia and used as frequent seasoning agent in Asia, Africa and Europe. Ancient Egyptians use garlic for both culinary and medicinal purposes. Garlic is a bulbous plant. It is one of the important bulb crops grown and used as a spice or condiment throughout India. It is also important foreign exchange earner for India. Garlic has higher nutritive value than other bulb crops. It is rich in proteins,

phosphorous, potassium, calcium, magnesium and carbohydrates. Ascorbic acid content is very high in green garlic. Allicin has been found to be the compound most responsible for the "hot" sensation of raw garlic [12].

3.1 Scientific Classification of Garlic [10]. Table.3

Kingdom	Plantae
Clade	Angiosperms
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Family	Amayllidaceae
Subfamily	Allioideae
Genus	Allium
Species	<i>A.cepa</i>

3.1 Cultivation and Production of Garlic

Garlic is easy to grow and can be grown year-round in mild climates. Garlic plants are usually very hardy, and are not attacked by many pests or diseases. Garlic plants can be grown closely together, leaving enough space for the bulbs to mature. Garlic does well in loose, dry, well drained soils having high organic content in sunny locations. Large cloves, along with proper spacing in the planting bed, will also improve bulb size. It grows up to 1.2 m (4 ft) in height. It produces hermaphrodite flowers. Pollination occurs by bees and other insects. Garlic is grown globally, but China is by far the largest producer of garlic in the world, with around 20 million tonnes (40 billion pounds) grown annually, accounting for over 81% of world output. India (4.6%) and South Korea (1.4%) follow, with Egypt (1.2%) on fourth place and United States of America in ninth place (0.8%). Much of the garlic production in the United States is centered in Gilroy, California calls itself the "garlic capital of the world"(APEDA, 2012). Madhya Pradesh ranks first in garlic production with 270 lakh tonnes followed by Gujarat (250 lakh tonnes) and Rajasthan (218.42 lakh tonnes) while Karnataka's production is 8.42 lakh tonnes and stands in 11th position in India (NHB, 2013). The garlic varieties (Spices board India) are Godavari, Sweta, Agri found White (G-41), Yamuna Safed (G-1) and so on.

3.1.1 Nutritive Value of Fresh Garlic

Garlic is rich in carbohydrate and calcium [10]. The insoluble dietary fibre in the form of inulin is 9 to 16 per cent in garlic [5] [13].

Table.4

Nutrient	Composition (%)
Energy K.cal	145
Moisture	62.80
Carbohydrates	29.00
Fibre	0.80
Protein	6.30
Fat	0.10
Mineral matter	1.00
Calcium	181mg

Iron	1.7mg
Magnesium	25mg
Manganese	0.86mg
Phosphorus	153mg
Sodium	17mg
Zinc	1.16mg
Copper	0.63mg
Zinc	1.93mg
Vitamin A	0.40 IU
Nicotinic acid	0.40mg
Vitamin C	13mg
Vitamin B	16mg
Riboflavin	0.23mg
Thiamine	0.06mg
Selenium	12.6microgram

3.1.2 Characteristic

Sulphur containing compound allicin is present in garlic. Hot sensation of raw garlic is due to presence of Allicin. On crushing, allinase present in the bulb acts on allin which is broken down to get allicin, diallyl disulphide oil that possesses the true garlic odour. The oil content in garlic accounts for 0.1% consists of diallyl disulphide (60%), diallyl trisulphide (20%), allyl propyl disulphide (6%), a small quantity of diethyl disulphide and probably diallyl polysulphide [14] [15].

IV. PREBIOTIC PRESENT IN ONION AND GARLIC WITH CHARACTERISTICS

Prebiotics are “Dietary food ingredients, not digested by host enzymes and selectively utilized by beneficial bacteria for their growth” [1] [16].

4.1 The Basic Prebiotic Criteria Are As Follows [17].

- Resistance to digestion
- Hydrolysis and Fermentation by few colonic microflora
- Selective stimulation of growth of probiotics-(live bacteria present in food supplement)
- Beneficial health effects to host

4.1.1 Classification of Prebiotics [5].

Table.5

TYPES OF PREBIOTICS	EXAMPLES	AVAILABILITY
Disaccharides	Lactulose	Human milk, cow milk
Oligosaccharides (OS)	Stachyose Levan type fructans	Soya bean Slime producing Lactic acid bacteria
	Xylo OS	Cottonseed hull

	Chitin OS	Crabs and shrimp
Polysaccharide	Fructans -Inulin Resistant starch	Chicory root Onion, Garlic,Banana

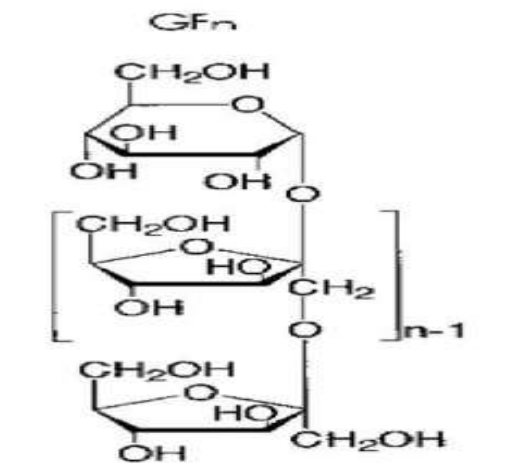


Fig.1 Chemical Structure of Inulin $(C_6H_{10}O_5)_n$

Molecular formula of inulin is GF_n

‘G’ - Terminal glucosyl unit.

‘F’ - Fructosyl unit

n - No of fructosyl units (approx.35)

‘F’ units - joined by $\beta(2-1)$ glycoside link, Chain length - 2-60 units.

Inulin is a naturally occurring polysaccharide made up of with fructose, a soluble dietary fibre termed as fructans that act as prebiotic. Extracted and purified inulin is white, amorphous and slightly hygroscopic powder having neutral taste and odour. It is soluble in hot water and moderately soluble in cold water. The molecular weight of inulin is approximately 5000 daltons with specific gravity of 1.35. Inulin has gelling characteristic that can be used to make fat cheese, soup, sauce and table spreads. Its melting properties (melting point – $178^{\circ}C$) allow for easy processing of frozen desserts. It is used in the production of cereal bars due to its binding characteristics. Inulin can be used as substitute for sucrose as it takes longer time to get digested and further glucose is released into blood and helps the diabetic patients [18] [19].

V. BENEFITS OF PREBIOTIC OF ONION AND GARLIC

Inulin passes through the small intestine and with the help of hydrolyzing enzyme present only in probiotic bacteria like bifidobacteria, lactobacilli that colonize the large intestine, which in turn promotes their population making a healthy gut flora. It is naturally present in bulb vegetables like onion and garlic having many health benefits. The digestion-resistant fibres present in these foods can be metabolized inside human lower digestive tract and converted into butyrate, propionate, and other short-chain fatty acids that can be used by the intestinal bacteria for energy [20] [21].

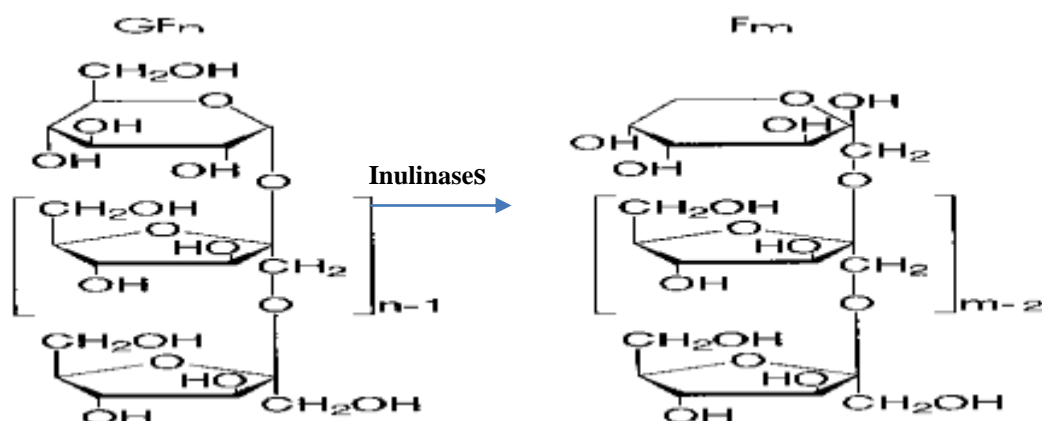


Fig.2

Inulin

- ✓ Inulin increases Bifidobacterial numbers
- ✓ Bifidobacteria is a probiotic bacteria
- ✓ Beneficial effects of probiotic bacteria in the human intestine include –
 - 1) Control of intestinal pathogens
 - 2) Benefit in Lactose intolerance condition
 - 3) Improvement in calcium absorption
 - 4) Synthesis of vitamins
 - 5) Control of serum cholesterol
 - 6) Anticarcinogenic activity
- ✓ Inulin itself can decrease the number of pathogens in the intestine

5.1 Uses of Onion

Onion is used as a food source from time immemorial. Onion helps in bowel movements and relieves headache, cough, snake bite and hair loss. Onions are a staple in Indian cuisine to thicken the gravy and as a flavouring agent. It is used in salads, chutney, pickle and so on as the main ingredient. Onion juice which is pungent is a moth repellent and can be rubbed on the skin to prevent insect bite, application onto the scalp promoted growth of hair. It is used to polish copper ware to prevent rust on iron. Chopped onion in boiling water after cooling may be used as a spray on plants and cats as an insecticide. Skins of onion have been used to produce a yellow-brown dye [22].

5.2 Uses of Garlic

Garlic is widely used around the world for its pungent flavour as a seasoning or condiment. The garlic plant's bulb is the most commonly used part of the plant. With the exception of the single clove types, garlic bulbs are normally divided into numerous fleshy sections called cloves. Garlic cloves are used for consumption (raw or cooked) or for medicinal purposes. They have a characteristic pungent, spicy flavour that mellows and sweetens considerably with cooking. Garlic is a fundamental component in many or most dishes of various regions, including eastern Asia, South Asia, Southeast Asia, the Middle East, northern Africa, Southern Europe and parts of South and Central America. It is used in seasoning to impart flavour, made into pickle and eaten raw to reduce blood serum cholesterol level [23].

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