

Processing of garlic: Present status and prospects

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India ranks at second position with share of 5.17 per cent of global area under garlic cultivation. Among dehydrated and processed garlic products *viz.*, dehydrated garlic flakes, garlic slices or rings, garlic grits, garlic tablets, garlic pickles, garlic powders, digestive churns, paste, garlic salts are most demanded processed product at national and international level due to nutritional compositions, health benefits and medicinal properties of garlic. Nutritional quality and flavouring component wise Indian garlic is much better and as a result there is better demand in ethnic markets. The demand of dehydrated and processed food has increased manifold in last few decades. India has emerged as prominent exporter of dried and preserved vegetables during last few years. In year 2015-16, totally 66189.62 MT dried and preserved vegetables are exported with earnings of foreign currency of Rs. 91420.85 Lac. Value addition through processing of the bulbs in the form of dehydrated flakes, dehydrated powder, paste, etc. will be instrumental in substantially expanding the export basket of garlic and its derivative products. Lot of market oriented research and efforts are needed in this prospect. There must be policy implementation for startup of garlic processing units in areas identified as production hub of quality garlic. Public-Private partnership in production and R&D sectors will offer better opportunities to focus and elevate garlic processing industry in India.

Key Words : Garlic, Processing, Nutritional quality, Export

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INTRODUCTION

Garlic (*Allium sativum* L.) belongs to family Alliaceae. The name garlic is derived from old English word 'gar' means presumably referring to the clove. Its origin is Central Asia (Rai and Yadav, 2006) and it is then spread to Mediterranean region. Now it is grown throughout the world. It is a herbaceous annual species, producing narrow and flat leaves. It is grown for medicinal usage in pharmaceutical industry also. Garlic is one of the most important commercial spice crop, valued for seasoning and flavouring vegetables and meat dishes. It

has a unique flavour and the particularity of improving the flavour of other foods and therefore, it is often used for culinary purposes. In India garlic is harvested in the month of March – April and stored throughout the year. Due to the fluctuations in daily environmental conditions in our region, it is very difficult to maintain the quality and quantity of garlic during storage period. Due to these reasons, there is inadequate availability of garlic bulbs in the market as compared to demand. So consumers have to make it available in different forms *viz.*, dehydrated cloves, garlic paste, minimally processed garlic, dehydrated powder etc.

The important link in the post-harvest chain is primary processing and the main objective of processing is to ensure the maximum off season availability. India is the second largest producer of vegetables after China. At least 50 to 60 per cent of the total production of fruits and vegetables in the country is lost due to improper post-

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harvest management and low processing capacity. The total wastage in terms of value estimated to tune of Rs. 23,000 crores per year. These huge wastage of valuable commodities need to be checked timely by diverting the excess production towards the preparation of different commercial processed products (Roy and Pal, 2000). This will be helpful in improving the rural income and creation of more employment opportunities and also better nutrition to the consumers from rural and urban masses. Also the demand of dehydrated and processed food has increased to manifold in last few decades. India has emerged as prominent exporter of dried and preserved vegetables during last few years. In year 2015-16, 66189.62 MT dried and preserved vegetables are exported with earnings of foreign currency of Rs. 91420.85 Lac. This export of dried and preserved vegetables have registered annual growth rate of 7.92 per cent (Anonymous, 2016). Major export destinations are Germany, UK, USA, Russia, Belgium, Brazil, Poland, Spain, South Africa, Netherlands etc. Conversely the processing share of garlic in India is negligible even less than 1 per cent of the total production. There is urgent need to focus and elevate garlic processing industry in India. Among dehydrated and processed garlic products viz., dehydrated garlic flakes, garlic slices or rings, garlic grits, garlic tablets, garlic pickles, garlic powders, digestive churns, paste, garlic salts are most

demand processed product at national and international level due to its nutritional compositions, health benefits and medicinal properties. Nutritional quality and flavouring component wise Indian garlic is much better and as a result there is better demand in ethnic markets in Singapore, Indonesia, Bangladesh, Sri Lanka, Philippines and UK.

Nutritional and medicinal importance of garlic :

Garlic is the only spice in the spices kingdom which has all the vitamins, minerals as well as the trace elements. It is a rich source of protein and minerals like P, K, Ca, Mg, and S. It also contains vitamin C and has got a reasonably high calorific value. Nutritive composition of fresh and dry garlic cloves *i.e.* dehydrated powder is shown in Table 1. In addition, it contains 0.06 – 0.1 per cent volatile oil. The chief constituents of garlic oil are diallelyl disulfide (60%), diallelyl trisulphide (6%), a small quantity of diethyl trisulfide and probably diallelyl polysulfide.

Garlic has been described as a hot stimulant, carminative, anti-rheumatic and alterative. Garlic oil is said to be a powerful antiseptic. It is used as vermifuge for expelling roundworms and has long been recommended for cure of number of ailments viz., wounds, foul ulcer, bronchitis, atopic dyspepsia and

Table 1 : Chemical composition and nutritive value of garlic

Particulars	Fresh peeled cloves	Dehydrated powder
Moisture (%)	62.80	5.20
Protein (%)	6.30	17.50
Fat (%)	0.10	0.60
Mineral matter (%)	1.00	3.20
Fibre (%)	0.80	1.90
Carbohydrates (%)	29.00	71.40
Energy (Kcal)	145.00	-
Calcium (%)	0.03	0.10
Phosphorus%	0.31	0.42
Iron%	0.001	0.004
Niacin (%)	0.04	0.70
Sodium (%)	0.02	0.01
Magnesium (mg/100 g)	1.93	-
Vitamin A (IU)	0.40	175.00
Vitamin C (mg/100 g)	13.00	12.00
Vitamin B (mg/100 g)	16.00	0.68
Vitamin B ₂ (mg/100 g)	0.23	0.08
Thiamin	0.06	-

Source : (Pandey and Bhonde, 2003) and (Pruthi, 1979)

gastrointestinal disorders. Insecticidal, antibacterial, antifungal, antitumor, hypoglycemic, hypolipidemic, antiatherosclerotic, fibronolytic, and antiplatelet-aggregation effects of garlic have been reported. In *Ayurveda*, garlic is considered as one of the most effective antimicrobial herbs as it has anti-bacterial, anti-fungal, anti-viral and antiseptic properties (Gupta and Lawande, 2010).

Present scenario and export trend of garlic :

From Table 2, it is seen that on global scale China is the leading country in garlic production and with highest share (82.86%) for production. India ranks at second position with share of only 5.17 per cent of global area under garlic cultivation for year 2014-15. This gigantic difference avails huge scope for India to become major player in international market.

Figures from Table 3 represents Indian scenario of garlic production. During 2014-15 garlic was cultivated on 262060 hectare area which yielded 1425460 MT

produce with average productivity of 5.44 tonne ha⁻¹. Madhya Pradesh is leading state both in terms of area and production of garlic followed by Gujarat. However highest average productivity was reported from West Bengal.

India has exported 1,55,0.0469 MT of Garlics in fresh and chilled form valuing foreign exchange of Rs. 7316.62,956 Lac. The export trend of last two years for period January 2014 to November 2016 is depicted in Fig. 1. On a year on year basis this translates to a jump of 1414 per cent in quantity terms and 869 per cent in value terms thereby turning India from a net importer to a major exporter in the global trade of garlic. From the trend of export it is observed that there is critical gap in supply in Europe from February to June whereas India has ample production during these months. European market being stringent, lot of market oriented research would be needed in production, grading, packing and shipment. Systematic export promotion can develop this niche furthermore

Table 2 : Top 10 garlic producing country in the world (2014-15)

Sr. No.	Country	Production (MT)	Share(%)
1.	China	2,00,58,388.00	82.86
2.	India	12,52,000.00	5.17
3.	Bangladesh	3,12,000.00	1.29
4.	Egypt	2,63,167.00	1.09
5.	Russia	2,56,406.00	1.06
6.	Myanmar	2,08,900.00	0.86
7.	Ukraine	1,91,140.00	0.79
8.	Spain	1,77,420.00	0.73
9.	Uzbekistan	1,54,130.00	0.64
10.	Argentina	1,48,953.00	0.62

Source: Food and Agricultural Organisation (FAO), 2016

Table 3 : Major garlic producing states in India (2014-15)

Sr. No.	State	Production (000 MT)	Area (000 ha)	Average productivity (t/ha)
1.	Madhya Pradesh	424.50	81.17	5.23
2.	Gujarat	318.20	40.60	7.84
3.	Uttar Pradesh	196.13	33.86	5.79
4.	Rajasthan	172.04	50.16	3.43
5.	Assam	70.17	10.18	6.89
6.	Punjab	65.60	5.89	11.14
7.	West Bengal	40.00	3.35	11.94
8.	Maharashtra	40.00	3.50	11.43
9.	Haryana	35.83	4.44	8.07
10.	Odisha	35.50	10.90	3.26

Source: National Horticulture Database (NHB), 2015

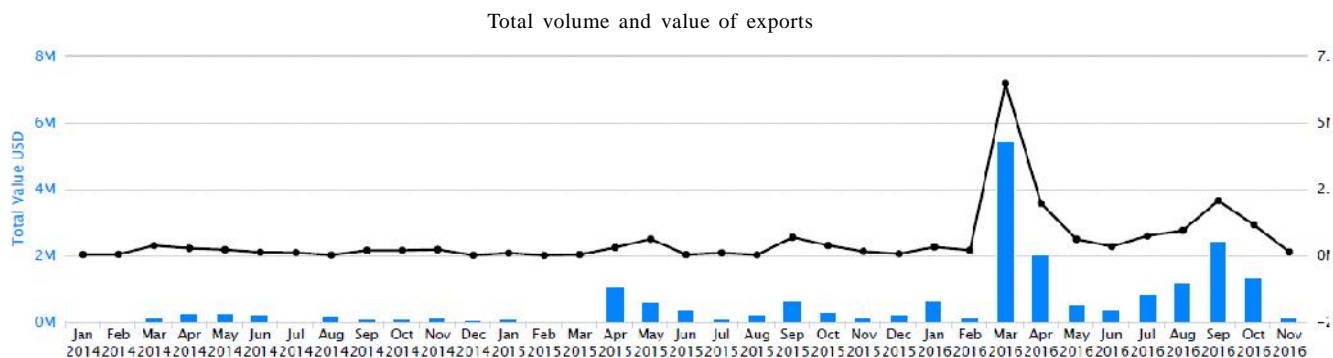


Fig. 1 : Export trend of garlic for period January 2014 to November 2016

Source: Agricultural and Processed Food Products Export Development Authority (APEDA), 2017

Consumption pattern :

The consumption and per capita availability of garlic is highest (11.4 kg/capita/year) in Korean Republic. In India it limits to 0.340 kg/capita/year only (Singh, 2011). NHRDF, Nasik has done an extensive sample survey covering 12 states with sample of 6975 rural (52 districts) and 5530 urban (53) districts families and noted highest per capita consumption of garlic in Gujarat 5.28 g/person/day followed by Punjab 4.85 g/person/day, Himachal Pradesh 4.78 g/person/day, Haryana 4.63 g/person/day, Rajasthan 3.61 g/person/day, Delhi 3.22 g/person/day, Uttar Pradesh 3.17 g/person/day and lowest consumption noted in Tamil Nadu 2.75 g/person/day against the national average of 3.88 g/person/day (Gupta *et al.*, 2015). This consumption array in very little measure and non-preference of garlic by many Indian people may be due its repulsive flavor in fresh form. Another reason for which people do not use garlic is that, they consider it as a non-vegetarian item. Garlic consumption is prohibited in certain religion due to “tomic nature” and due to some side effects (Gupta and Lawande, 2010). The development

of odorless, less repulsive dehydrated garlic products with wider consumer acceptability in various forms and creating awareness for health benefits will boon consumption and demand of garlic and its processed products in India.

Products of garlic :

Though garlic is produced abundantly and consumed as such, little efforts have so far been made to produce dehydrated garlic and garlic powder. These are some of the products and their specifications (Table 4) prepared from garlic –

Dehydrated garlic powder:

It is homogenous product, 95 % of which passes through a sieve of an apertures size of 250 u m.

Dehydrated garlic flakes or pieces:

These are products passing through a sieve apertures size from 1.25 mm to 4 mm. The particles have an irregular shape and size.

Table 4 : International physico-chemical specification for dehydrated garlic

Sr. No.	Physico-chemical characteristics	Quality parameters	
		Garlic slices, rings, flakes, pieces	Garlic powder
1.	Moisture content, % (m/m), max	8	6
2.	Total ash, o/u (m/m) (dry basis), max	5.5	5.5
3.	Acid-insoluble ash, % (m/m) (dry basis)	0.5	0.5
4.	Cold water soluble extract, (%) (m/m) on dry basis, min	0.3	0.3
5.	Cold water soluble extract, % (m/m) on dry basis minimum	70	70
6.	Maximum	90	90
7.	Extraneous matter % max	0.5	0.5

Source: International Organization for Standardization (ISO) 5560-1983, International standard for dehydrated garlic and garlic powder

Dehydrated garlic slices:

It is a product prepared by cutting garlic cloves into slices and removing broken pieces smaller than 4 mm by sieving.

Garlic paste:

Singh *et al.* (2014) described a method for making garlic paste with the same flavour as fresh garlic. The cleaned bulbs are broken into cloves, peeled and boiled carefully to obtain a homogeneous paste. To ensure a pleasing appearance and good shelf-life an addition of 0.1 % SO₂, 15 % NaCl and 0.05 % ascorbic acid is recommended.

Pickled garlic:

Whole, sliced, cubed garlic is pickled in vinegar or brine or vegetable oil or their combinations. Pickling garlic in vinegar leads to formation of S-allyl cysteine.

Garlic salt :

Garlic salt is prepared of a free flowing, uniformly blended dry mixture of non-iodized salt. It has greater culinary latent than powder and one tablespoon is equivalent to clove of fresh garlic (Vaddoria *et al.*, 2014).

Garlic oil:

Garlic oil is derived by steaming crushed garlic and capturing the resultant oil released. The yield of garlic oil is around 0.46-0.57 per cent on moisture free basis, and it makes it quite expensive. The specific gravity and refractive index of garlic oil at 25°C is 1.091-1.098 and 1.5740-1.5820, respectively. (Sokhansanj and Jayas, 1987). It is reddish brown over powdering liquid. One gram of oil is equivalent in flavoring terms to 900 g fresh or 200 g dehydrated garlic powder. The high pungency of garlic oil makes difficult to use it. The oil is commonly used in vegetable oil. (Bhonde *et al.*, 2012).

Garlic oleoresin :

Garlic oleoresin is also extracted which is dark viscous liquid, having 12 times the flavor of dehydrated garlic and 50 times that of fresh garlic cloves.

Varieties for processing and their characteristics :

In context to processing requirements, very few Indian genotypes or varieties are suitable. The Indian genotypes have smaller bulbs, more number of small

cloves making it difficult in processing. For dehydration, white varieties with fewer, bigger cloves are preferred. Garlic dehydration and processing needs special skill, control and care (Chaudhari and Dhake, 2016). As reported by Singh and Gupta (1998), the garlic varieties Yamuna Safed – 5 (G-189) and Yamuna Safed – 4 (G-323) developed by NHRDF, Nasik having bigger cloves, bulb size, higher yield potential have found suitable for dehydration.

Yamuna Safed 4 (G323):

Bulbs are silvery white and average diameter is 3.54.0 cm. Number of cloves 20-25/ bulb. Recommended for North and central India.

**Yamuna Safed 5 (G189) :**

Bulbs are creamy white and bigger sized 4.55 cm in diameter. Number of cloves/ bulb is 2230. Suitable and recommended for processing purpose in view of having desired dehydration qualities



and recommended for growing in Sikkim, Meghalaya, Manipur, Nagaland, Mizoram, Tripura, Arunachal Pradesh, Andaman and Nicobar Island, Punjab, Tarai region of Uttar Pradesh, Uttarakhand, Bihar, Jharkhand, Gujarat, Rajasthan, Haryana and Delhi

Processing technology and machines required for garlic processing -

The simple and low cost Garlic processing machines and technologies for processing developed by Department of Processing and Food Engineering, CTAE, MPUAT, Udaipur are:

- Garlic Grader
- Garlic bulb breaker
- Garlic clove flaker
- Dry Garlic peel remover (de-skinner)
- Fresh Garlic clove peeler

Also for the dehydration practices various kinds of advanced dryers *viz.*, cabinet dryers, solar dryers, vacuum dryers etc. are used depending upon the production capacity, product types etc. The technologies for odorless garlic powder, garlic paste garlic crush, garlic oil and oleoresin and other processed products have been

Table 5 :

Sr. No.	Particulars	Capacity utilization(Rs. in '000)			
		100%	80%	70%	60%
1.	Fixed cost	293.36	234.69	205.35	176.02
2.	Variable cost	917.00	733.60	641.90	550.20
3.	Cost of production	1210.36	876.59	847.25	726.22
4.	Projected sales	1500.00	1200.00	1050.00	900.00
5.	Gross surplus	289.64	231.71	202.75	173.78
6.	Expected net surplus	238.00	181.00	152.00	123.00

All figures mentioned above are only indicative based on project profile for establishing new small scale processing unit

developed by Central Food Technology Research Institute (CFTRI), Mysore.

Estimated cost analysis of garlic processing unit :

In Table 5, a general cost estimation of small scale garlic processing unit established under credit link based subsidized loan scheme KVIC – REGP (Gramodyog Rojgar Yojana) with annual processing capacity of 75 t raw material is presented.

Future thrust areas and strategies :

– Expansion of processing industry will demand production of more garlic. Therefore early maturing, high yielding, high TSS varieties suitable for processing should be developed for providing strong base for processing industry.

– Contract farming for processing should be promoted to ensure better prices for growers and assured, supply of quality raw material to processing units.

– Post-harvest technology is to be strengthened with special emphasis on storage, packaging and transport.

– Awareness should be created among people for health benefits of garlic and its processed forms to establish market at domestic level.

– For survival and strengthening of garlic processing industry in India, strong and planned government support is needed.

– Systematic export promotion of the products with international standards and brands should be done.

– There must be policy implementation for startup of garlic processing units in areas identified as production hub of quality garlic. Public-Private partnership in production and R&D sectors will offer better opportunities.

Conclusion :

Value addition through processing of the bulbs in the

form of dehydrated flakes, dehydrated powder, paste, etc. will be instrumental in substantially expanding the domestic market and export basket of garlic and its derivative products. It will also offer better prices to growers and assured quality supply of Low Volume – high Nutrition containing processed food to consumers. The integrated approach will uplift processing industry by offering vast opportunities for employment generation in processing sector.

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