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King chilli (*Capsicum chinense* Jacq.), "The India's hottest chilli"- An Overview

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Abstract

King chilli (*Capsicum chinense* Jacq.) is an indigenous variety of capsicum to the northeast region of India and has been familiar as the hottest chilli in the World. In this article possible nutritional value of king chilli was studied for the health benefit. It has also been great prospective for its pungency and medicinal value utilized by the native people of the northeast India. It is consumed in different form as normal chilli but have especial demand on national and international markets for its extra powerful pungency and aroma. Even though being a valuable crop with high potential value for income sources for the indigenous people, so it is essential to emphasis on studies directed towards the different systematic production (morphological, cultivation practices, postharvest processing and marketing) of king chilli. Due to high demand there need to standardize the production and postharvest technology which may help to improve the yield, quality and shelf life extension for long chain marketing and distribution. The present review is focused on production and processing practices of king chilli.

Key words: King chilli, postharvest, capsaicin, proximate composition, marketing distribution.

Introduction

Chillies (*Capsicum annum* L.) are one of the most important spices cum vegetable crop grown in India with great export potential. Chilli is a most valuable fruit cum vegetables in all over the world and production is about 18.8 MT which grown over 1.4 million hectare of fresh and dry chillies fruits in India (Krishna *et al.*, 2007). Chillies are used as food additives or spices in many national cuisines due to their sensory attributes of colour, heat, pungency flavour, and aroma. Chillies are a good source of vitamin A, C, and E, but the concentration depends on the cultivar(Bosland and Votava, 2000). Chillies were used fresh, canned, pickled, frozen, fermented, dehydrated, or processed to chilli powder. The medicinal values being identified scientifically in recent years and the presence of high level of antioxidants, anti-cancerous elements, capsaicin as a muscular pain reliever, have added additional importance (Shivanand, 2005).

King Chilli (*C. chinense*. Jacq) also called "*Bhut Jolokia*" placed among hottest chillies (Wikipedia, April 2013), is an indigenous cultivar growing in Nagaland, Manipur and other part of northeast India. The king chilli focused and declared it is as hottest chilli of the World when reported by Defence Research Laboratory, Tezpur, Assam, India. And has recorded that it is hottest chilli with 1001304 SHU (Verma *et al.*, 2013). The capsaicin content of king chilli fruits has been found to be very high in comparison to the fruits of the other chilli species (Baruah *et al.*, 2014; Sanatombi and Sharma, 2008).The high foothill conditions with high nitrogen available of the region are suitable for the cultivation and production of a extensive range of capsicum crops including king chilli (Rongsennungla *et al.*, 2012 ; Sharma, 2014). Monsoon season with high humidity is ideal for the cultivation of the crop (Anon., 2008). Due to high pungency and aroma of the king chilli it has an enormous scope both in international domestic market. It has been reported that production of king Chilli is increased every year in north-eastern India(Meetei *et al.*, 2016).

Green king chilli has the huge demand due to it aroma (Elias and Hossain, 1984). Also in season the price of green King Chilli (*bhut jolokia*) is reasonable having 300-400 per kg but in off season the market price rises up(Malangmeih and Rahaman, 2016; Meetei *et al.*, 2016). Huge quantity of green chilli has been found to be wasted in the field due to the lack of proper processing and preservation technology. After harvesting of king chilli the increase the shelf-life of green king chilli is very challenging due to its perish-ability; it is subject to quick worsening the shelf life during storage, transportation, and marketing. (Chitravathi *et al.*, 2015; Edusei *et al.*, 2012). Freshness is a prime requirement of green peppers consumed in India. However, freshness loss and reduced shelf-life occur because most supermarkets and retailers handle peppers improperly without optimal packaging and storage and quality can be improved and shelf-life extended for fresh king chilli by modified atmosphere packaging MAP (Azlin *et al.*, 2014; Krishna *et al.*, 2007; Naik *et al.*, 2001).

Botanical and morphological characters of king chilli: King chilli is the fruit of plant belonging to Capsicum species. Family: Solanaceae Genus: Capsicum Species: *C. frutescens* Jacquin, these chillies are one of the hottest chillies on earth and the extreme variations among different cultivars include several colours, sizes and textures of fruits. Particularly the colour ranges from light green, yellowish green to dark green in young fruits and gradually changes into light red, bright red and even chocolate while the texture varies from crumpled to semi smooth as well as gloomy with fleshy tissue as shown in Fig. 1. The fruit

Fig. 1. King chilli at different maturity (i) Green (ii) Yellow Green (iii) Brown

is sub-conical to conical in shape and about 2.40-2.85 cm wide at the shoulders and 6.10-9.20cm in length; Fruit surface: Rough, wrinkle with spikes and may weigh 14-18 g.

Cultivation and production: This chilli is grown mainly in the state of Nagaland, Assam and Manipur and to some extent in Mizoram, Arunachal Pradesh and Meghalaya which starts during February - March mainly in the hilly area and September-October in plains area (Baruah *et al.*, 2014).King chilli is highly perishable non-climatic crop can be grown all the types of soil, but a deep loose soil is preferred. Good quality king chilli can be produced under clay loam soil (Borgohain and Devi, 2007). The soil should be rich in organic matter with of pH 5.5-6.0. King Chilli grows in monsoon climatic condition with generally high humidity. The rainfall range for cultivation is wide, ranging from 1200 to 4050 mm per annum and the climate is moderate with temperatures ranging between a maximum of 36 ºC in summer and a minimum of 12 ºC in winter (Anon, 2008). The cultivation practices should be well prepared of land preparation, proper showing and transplanting, management of manuring and fertilizers and taken care of control the insect, pests and diseases for better cultivation and higher yield. The picking of either mature green or red fruits depends upon the market demands. The number of picking varies from 15- 45 days depending upon the growth and development of fruit (Meetei *et al.*, 2016; Sharma, 2014).

Best practice for production of King chilli with proper soil treatment & mixture, treat the seed with bio-fertilizer like azotobacter and phosphotika and sow seeds in line at about 5 cm apart to avoid overcrowding of the seedlings. Mulching should be provided and irrigate the nurseries every alternate day in the evening. When the seedlings become mature, it is ready for transplanting to the, main field. Seedling root dip should be done for about 30 minutes in 1 kg Azotobacter and 1 kg Phosphotika in about 100 lts. Naga King Chilli is a rainfed crop but watering should be done mixed with bio-agents at regular intervals.

King chilli Production statistics (2010-2017)

Year	Area (ha)	Production(MT)
2010	350	1470
2010	350	1470
2011	500	2000
2012	435	1760
2013	500	2400
2014	610	2600
2015	690	2480
2016	820	2750
2017	1050	3420

Also greenhouse production technology of King Chilli standardized technology of King Chilli. Greenhouse King Chilli grows rapidly under optimum environmental conditions, and fruit production begins 50-60 days after transplanting. For good fruit production, a temperature range of 25- 28 ºC during the day is desirable. Fertilizer management practices will, therefore, have to be planned to ensure that plant requirements are satisfied to achieve good yields of high-quality fruit. Harvest fruits when it has reached a uniform diameter throughout its length and may be harvested in green stage or as per choice in red ripe stage (50-65 days after flowering)(Katwale and Saraf, 1990). As soon as possible after harvest, fruit should be placed under conditions that will prolong its storage life. Packaging of fruits in shrink-wrap film before packing in cartons prevents moisture loss and maintains fruit quality. The best storage temperature is 10 °C, 3 % O_2, 5 % CO_2 with a relative humidity of 80-90 % (Chitravathi *et al.*, 2015). Production of King Chilli increases in Nagaland throughout the year as shown in Table.1. (Source: NEFDi Data Bank and Horticulture Department, Nagaland)

Harvesting practices: Naga King Chilli takes about 5 months to reach the harvesting stage from the time of transplanting. It is harvested at three different stages - green, yellow and ripened stages. For long distance market and vegetable purpose, harvesting is done at the green stage. For drying, pickling and seed purpose, it is harvested at yellowing to red stage. 50 plants yield about 6 kg fresh fruit per week for three months, which comes to approximately 1.5 kg per plant in three months. The average fresh fruit yield of this chilli is around 80-100q /ha under rainfed condition while dry weight ranges from 10-12 q/ha.

Composition of king chilli: Fresh matured materials king chilli are procured from the local farmer's field located at Guwahati (Northeast, India).The proximate chemical composition such as moisture, ash, protein, fat, fiber, carbohydrate, TSS energy and ash content of green as well as red king chilli were determined. The standard official AOAC methods 19th Ed, 2012 are used for the determination of the above mentioned parameters also as described by(Orellana-Escobedo *et al.*, 2012). Color was determined by Hunter Lab Colorimeter on CIE L*a*b* chromatic space, L (degree of lightness to darkness), a (degree of redness to greenness), b (degree of yellowness to blueness) values.

Proximate compositions of the king chilli were shown in Table 1. Previous researched in Indian chili peppers showed results for moisture, ash, and protein on an average basis 81.94 g, 1.27g, and 1.82 g, respectively (Tandon *et al.*, 1964). Proximate composition was slightly different (moisture 68.50 g, ash 1.34

Table 1. Composition of King chili

Compositions	Green stage
Moisture (g/100g)	84.56 ±0.76
Ash (g/100g)	1.46 ±0.07
Protein (g/100g)	1.45±0.06
Carbohydrate (g/100g)	6.89 ±0.07
Fiber (g/100g)	1.67 ±0.01
Fat (g/100g)	0.1 ±0.01
Energy (K.Cal)	42.78 ±0.12
Vitamin C (mg/100g)	118.45 ±0.66
TSS (^{O}Brix)	3.19±0.02
L	32.65 ±0.79
a	-12.09±0.18
b	22.55±0.57

g, protein 4.00 g, and fat 1.10 g) and also carbohydrate content reported an average of 56.25 %. Sweet pepper was found to have the highest crude protein value (3.51%) while the least value was found in bell pepper (2.64 %) (Orellana-Escobedo *et al.*, 2012; Simonne *et al.*, 1997). The metabolizable energy values ranged from 196.33 KJ/mg (bell pepper) to 255.51 KJ/mg and fat content ranged from 1.52% in Capsicum annum (Sweet pepper) 2.87% *C. frutescens* (Cayenne pepper)1.2 % ash (Ogunlade *et al.*, 2012). The proximate composition of capsicum fruit was varying from variety to variety and location to location (Howard *et al.*, 1994)

Postharvest management king chilli in northeast India: In India chilli is used in three different forms such as fresh green chilli, red grind and raw red. Ripen chillies are traditionally sun dried and procedure takes 3 to 4 days, depending on the weather conditions and then grinds in local huller mill and stored chilli (Elias *et al.*, 1984).Mainly dry king chillies are sold due to very high level of perishability of king chilli. The Naga King Chilli has a poor shelf life and deteriorates fast if stored under normal conditions for a long period. However, in cold storage the product may be stored for 8-10 months.

Packaging and storage structures: Packaging is an important function for every produce and so is in marketing of Chili. It is a practice to protect the produce from any damage during storage, transportation and other marketing aspects. Green chilies can be preserved and prevented from turning it red by removing the stalk and storing them in dry bags. Good packaging of chili not only facilitates convenience in transportation and storage but also attracts consumer to pay more. In India chilies are packed mostly in gunny bags and rarely in bamboo are baskets (North eastern states). Only the exporters packed them in to good new gunny bags and sometimes low density polyethylene film pouches (Anon, 2008).

Suitable marketing opportunities and infrastructure for processing for king chilli in this part of the country would help in promoting the cultivation of the crop. Since the King chilli has the potential to become a major crop and reasonable pricing to production so as to make this crop more popular among the farmers. (Meghvansi *et al.*, 2010). Fresh king chilli can be transported from northeast to other parts of the country where population growing like Delhi, Bangalore, Mumbai, Kolkata due to pay premium prices for the product(Sharma *et al.*, 2010) for improving the marketing system of this crop.

Preservation and marketing of king chilli: The shelf-life of this chilli is limited to 3-5 days as a result of which considerable post-harvest losses are incurred. Pre-harvest sprays of plant growth regulators and other chemicals are known to be effective in enhancing the growth, yield, quality and shelf-life of King chilli (Katwale and Saraf, 1990). After harvest, chillies and peppers fruit remain biologically active and change in respiration rate, color, firmness and water loss. Shrivel and wilting an important effect on visual quality of chillies (Bosland and Votava, 2000). Chilli, a non-climacteric fruit (*Capsicum annuum* L.) deteriorated quickly during postharvest handling and storage (Naik *et al.*, 2001). Postharvest treatments e.g. low temperature storage, packaging etc. can delay these physiological changes, maintain quality and prolong storage life of chilli and pepper fruit (Chitravathi *et al.*, 2015; Manolopoulou *et al.*, 2010; Nyanjage *et al.*, 2005; Rahman *et al.*, 2012).

The Naga King Chilli has a poor shelf life and deteriorates fast if stored under normal conditions for a long period. However, in cold storage the product may be stored for 8-10 months. Since the pungency of Naga King Chili is affected by several factors including agro-climatic conditions, studies on finding optimum conditions to achieve the maximum pungency level would be of great benefit. In-depth research should be directed towards phytochemical and pharmacological investigations of Naga King Chili that could excavate novel bioactive compounds. The highest price was seen in the month of July-August and lower prices were seen from the months of September to January in all the markets. The chilli was found to fetch as high as Rupees 600 to 800 kg^{-1} in the month of July and April and as low as rupees 200 per kg during the period of September to January (Malangmeih and Rahaman, 2016). The quality and the scarcity of the chilli were high at the beginning of the harvest and the price shot up against the end of season.

Potential value of king chilli: Despite the long use of this fruit, a limited number of scientific studies and publications are available on King Chilli (*C. chinense* Jacq.). This variety is indigenous to the Northeast region of India but scientifically it has not been explored to its fullest so the people of the north eastern India used the fruits of in different food formulations like flavouring curries due to its high-quality fragrance pungency, capsaicin which is great potential value in medicinal field (Davis *et al.*, 2007; Hayman and Kam, 2008; Kouassi *et al.*, 2012; Wesołowska *et al.*, 2011) so it used for various medicinal treatments like headache, night blindness spondylitis, digestive diseases (Sarwa *et al.*, 2012) and to reduce chronic congestion (Bhagowati and Changkija, 2009). *Bhut Jolokia* is contains very high capsaicinoid content, ranging from 2.45% to 5.36% (Liu and Nair, 2010; Sarwa *et al.*, 2012). the production of capsaicin in cell cultures revealed that Naga King Chili has the potentiality to biosynthesize capsaicin significantly as compared to other species This capsaicinoid cause the spicy flavour (pungency) of chilli pepper fruit and capsaicin found in capsicum species has been reported to have various pharmacological activities and some of the clinical applications (Ochoa-alejo and Ramirez-malagon, 2001). So the king chilli has potential application and can be utilized in different medicine purpose like Pain reliever, Cancer prevention, Reduction of weight, Gastrointestinal benefits, Anti-inflammatory property, Antioxidant activity etc. As a result, it is an ideal chilli variety needed for its commercial extraction of capsaicin for its utility potential in pharmaceutical industries (Higashiguchi *et al.*, 2006).

King chilli is a fruit cum vegetable with great economic importance. King chilli had lots of nutritional values and it contains capsaicin which medicinal potential and its commercial

implications in the pharmaceutical and food industry so demand also increases. Due to its high demand and high price the continuous production Practices and, utilizing better technical inputs rising off-season grower, better storage facilities and packaging, preservation handling in marketing chain distribution should be essential. Since its has high pungency aroma renders an immense scope both in domestic and international market so commercialization and scientifically explored thoroughly of the fruit essential which is good source of income for local farmers and also it offers great potential for future exploitation.

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