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Chilli Powder Quality Assurance: A Critical Review on Characteristics, Packaging, and Storage Practices

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Abstract: Spices exhibits an essential function in the enhancement of the aroma and taste of the manufactured foods. As spices are best known to impart aroma and taste to the foods, they have been consumed in large variety of the manufactured foods. Chilli is an essential spice crop and also India is one of the preceding producer and exporter of the chillies in the whole world. Chilliessharea major contribution in the dishes which are consumed on the daily basis and also hasan essential place in diet worldwide. Chilli is widely used around the world because of its taste and aroma imparting nature. Chilli is used both as the dried and fresh form in foods. Dried chilli powder is a spice product which is widely used for flavouring and colouring of the condiments in Asian cuisines. Chillies are the rich source of Vitamins – A, C, E, K, P, proteins and fats. Chilli powder used in households on every day basis, processed foods also utilize the spices in significant quantities. Therefore, the vital information regarding various characteristics, processing practices, packaging and storage of chilli are all reviewed in this article.

Keywords: Spices, chilli, dried chilli powder, flavour, aroma.

Review Paper

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1. INTRODUCTION

Chilli (*Capsicum annum)* is a vegetable fruit of plants which belongs to "Solanaceae" family. These are the fruits which are insignificant in size and are best known for their pungent flavour and colour. There are many pigments in chilli out of which main are capsanthin, capsorubin, zeaxanthin and cryptoxanthin. Carotenoids which are stable intact plant issue are accountable for the colour of the chilli spice powder. Chillies are dried and then grinded into spice powder. Dried chilli is the product which is mainly used for the flavouring and the colouring in Asian cuisines (Jitbunjerdkul and Kijroongrojana, 2007; Toontom*et al.* 2010). During the processing of the chillies the carotenoids of chilli auto-oxidize easily because of the exposure of the heat, sunlight and oxygen and which ultimately leads to more orange and less intense colouration. Chillies are the rich source of vitamin A, B, C, E and minerals Ca, P, Fe, Na and Cu in trace amounts. The pungency in chilli is because of the presence of the alkaloid capsaicin which is the active component and amide derivative of vanillylamine and 8 methyl-non-trans-6-enoic acid (Maria *et al.*, 1993). Capsaicin is present in placenta which is much irritant for mammals, including humans and produces the burning sensation. Dried chilli is measured by various parameters such as ascorbic acid, colour, pungency and volatile flavour compounds (Henderson, 1992; Ruth *et al.*, 2003; Jiang and Kubota, 2004; Kim *et al.*, 2006; Wang *et al.*, 2009; Yaldiz*et al.*, 2010). Dried chilli powder is extensively used in the flavouring and colouring of the foods. On the traditional basis, dried chilli is obtained by drying of the chilli in the sun which takes up to 7 to 20 days to reduce moisture content and it becomes susceptible to fungal proliferation. To prevent this, currently hot air drying is being adopted because of the short drying time, consistent heating and more hygienic characteristics. However freeze drying is also one of the appropriate method for the water removal as the final product by it is of the highest quality.

2. LITERATURE SURVEY OF WORK CARRIED OUT BY VARIOUS AUTHORS

2.1 CHARACTERISTICS OF CHILLI

2.1.1 Colour

Moisture content, storage, temperature, atmosphere and light are some of the factors that affect the oxidation of carotenoid pigments and which ultimately attributes the colour deterioration in the chilli powder and was given by Krishnamurthy and Natarajan (1973). Colour retention in chilli powder is also influenced by the factors like harvesting conditions, variety and the drying temperature. Kanner*et al.* (1977) found that powders having low (1%) moisture content which when stored at high temperatures results in the reduction of colour intensity. Enhancement in colour stability and prohibition in pigmentation can be done by

increasing the moisture levels to 14%. Colour deterioration during storage also gets affected due to the ripening period of the fruits from which the powder was processed. Pigment deterioration was observed less in the powder produced from the fruits that were harvested ripe but were still succulent than the powder that were kept at low moisture conditions which were allowed to dry on the plant for the considerable time. Carnevale *et al.* (1980) studied that the deterioration of colour became faster in the ground spice than the whole spice during the storage. Loss of colour was also accelerated with the exposure to the air and sunlight. Testing of seeds being in dry flesh or dry seed was given by Klieber and Bagnato (1999). Quality can be determined by the extractable surface colour and sensory analysis. Grinding when done by the hammer mill or the plate grinder can never influence the colour stability. Initial colour when diluted with seed, the decrease in the overall shelf was observed and also the rate of colour loss can be slowed by the addition of the seed to the flesh and also with no addition of the seed to the flesh can reduce the pungency and yield of the chilli. Bera*et al.* (2001) reported that the retention of red colour, checking of the growth of microorganism and the enrichment of the vitamin C content can be helped out by the addition of ascorbic acid in the red chilli powder thermally processed. Take *et al.* (2012) found that the red pigmented carotenoids presence results in the colour of the chilli spice powder. Capsanthin, capsorubin, zeaxanthin and cryptoxanthin are the main pigments. The carotenoids auto-oxidize easily when the chillies are dried and grinded into powder because of the exposure of heat, light and oxygen and which leads to more orange and less intense coloration which deteriorates the spice powder. Toontom and Meenune*et al.* (2012) found that the freeze dried samples of chilli powder gave more bright red colour than the sun dried and the hot air oven dried samples. Manjula and Ramachandra*et al.* (2014) found that the solar tunnel dried samples of chilli powder gave more bright red colour than the open yard sun dried samples of chilli. Saengrayap and Boonlap*et al.* (2016) studied that the improvement of dried chillicolour can be observed by the application of pretreatment. Cankaya*et al.* (2017) found that the most vital characteristics of the red chilli powder for the quality is the visual colour which ultimately affects the preferences of the consumer. Conclusion can be derived from this as long as the keeping quality is maintained by the attractive colour, dried red and green pepper powders are preferred more likely. The colour of the product is never affected by the fermentation of the product and there was not much difference between the pickled and control pepper samples.

2.1.2 Moisture Content

Guzman *et al.* (1973) reported that the ground capsicum with the minimum colour loss is observed at the moisture content 10 to 11% with the subsequent storage of -16°C. Chilli powder's moisture content was appeared to be critical (around 10%) during the storage for the colour retention as being studied by Kanner*et al.* (1977). Colour bleaching can take place due to the lower moisture levels while at high moisture levels due to browning reactions there was darkening but none of the change was observed in the carotenoid content. As stated by Kim *et al.* (1982) correlation of the stability of ascorbic acid and pigment is with the moisture content of chilli and which affects the hygiene problems also. Lee *et al.* (1992) studied that dried chilli having the range 10 to 14% could retard the colour loss which means that colour deterioration was observed to be less in the high moisture levels. For the retardation of pigmentation moisture content is concerned to be lower than 8%. Wall and Bosland (1993) studied that the as moisture content above 11% allows the mould to grow and excessive colour loss can be observed in the moisture content less than 4% so the ideal moisture content for the chilli powder is 8%. For the prevention of the aflatoxin production chilli needs to be dried to the moisture content of 13% as stated by Pitt and Hocking (1997). Acceptable limit of the moisture content in the export market is 10-11% (d.b.) and Indian chillies contain about 16% (d.b.) as studied by Singhal (1999). Microbial growth, non enzymatic browning and caking is resulted by the high moisture content of 18%. Doughas*et al.* (2005) found that the spices rapidly deteriorate under the adverse conditions and well maintained storage facilities should be provided to the powder. Saengrayap and Boonlap (2016) studied that the chemicals pretreatment would result in much moisture removal as the Na and Ca components of the solution altered the structures of chilli. The levels of solution concentration had no much effect on the moisture removal rate. So it is essential that spice should be stored at a safe and sound level mainly below moisture content of 10%.

2.1.3 Temperature

Studies by Lease and Lease (1956) gave up the thing that the deterioration of the colour can be slowed down by storage of the powder at the refrigerated temperature that is 5°C. As stated by Krishnamurthy and Natarajan (1973) that the blackening of the chillies and the discolouration of the chillies can be resulted by the storage of them at high temperatures as storage temperature shows the greater effect on the colour stability of the spice than the light, kind of container in which it was stored and the form of spice. Following the moisture and ambient temperature the discolouration of the spice can also be observed by the non-enzymatic browning as given by Lee *et al.* (1991). According to Klieber and Bognato (1999) shelf life acceleration can be done by the storage of chilli and two paprika powders in air at 37°C in the dark. Good shelf life is observed when chilli is kept in cold conditions and out of light. Product stone milled or commercial hammer milled produce the quality of product to the same equal characteristics. Rhim and Hon (2011) studied that temperature and water activity greatly effects the colour change in red pepper powder. Due to the deterioration of carotenoid pigments and development of browning components, when the

temperature and water activity increased appropriately red colour of powder fades away to become brown and tarnish.

2.1.4 pH Content

Sample's pH content depends on the type of soil, plant maturity level, freshness of the sample and the harvesting conditions which was given by Shankuntala (1995). Fresh chilli contains the highest pH and was the least in the titrable acidity values. Contamination from microbes cause the differences in the pH and titrable acidity. Decrease in pH and increase in titrable acidity is caused by the microorganisms mainly lactic acid bacteria which produce organic acids. Mangaraj*et al.* (2001) stated that sun dried chilli becomes more contaminated with the microorganisms than in the solar tunnel drying process. Satishkumar*et al.* (2015) studied that 4.90 to 5.06 were the pH values recorded in Byadagichilli powder. Toontom*et al.* (2012) stated that 3.21 and 4.84 was the pH value range observed. It was concluded from that the red chilli powder don't have high acidity. It means that the cause of indigestion is not due to acid in the chilli which was given by Kristen (2006).

2.1.5 Capsaicin Content

It is often observed that there is no effect of drying on the chilli's capsaicin content. Toontom*et al.* (2012) reported that capsaicin content varied between 0.09 and 0.1mg/100g of the dried chilli. High of capsaicin content was observed in the fresh sample. Kaewprasit and Kumngern (2009) and Noichinda*et al.* (2012) reported that capsaicin content of fresh chilli was 0.52-1.07 mg/g; 7500-16500 SHU. Capsaicin is also used in pharmaceutical and food industry. Peroxidase enzyme and temperature done during blanching and drying processes resulted in the low capsaicin content of fresh chilli than the dried sample of chilli. Bernal *et al.* (1993) studied that the capsaicin degradation can be observed due to the oxidation of vanillyl moiety by the peroxidise enzyme. In the sun drying case, due to the exposure to solar radiations which resulted in major two capsaicinoids degradation that are capsaicin and dihydrocapsaicin which are responsible for pungency in chilli.

2.1.6 Grinding

Minquez*et al.* (1993) studied that the generation of heat due to the milling by the hammer during the grinding of the paprika cause the degradation of yellow fraction while the red fraction was retained. Chen *et al.* (1999) stated that the commonly used particle size mesh of 18 and 30 in Korea don't effect on the hue angle and red powder chroma power of the cultivator but gives a significant effect on lightness. Significance of the particle size and moisture content interaction was shown in all of the colour parameters. Horvath and Hodur (2007) found that the average particle size was between range 260 and 320 μm of the powders. 6.85 and 7.56% were the moisture content values of the initial paprika powders. With the relative to the initial sample the moisture content was increased by 1, 2, 3, 4 and 5%.

3. EFFECT OF DIFFERENT DRYING TECHNIQUES ON THE QUALITY OF CHILLI POWDER

Gupta *et al.* (2018) by carrying out the experiments analysed the sun drying effect, for which sun drying and mechanical drying done at 50, 60 and 70°C were improved on different quality parameters namely ascorbic acid, capsaicin content, oleoresin matter and colouring matter of the red chilli powder. The chillies used in the experiment were whole and slit chillies. The best quality of all the parameters were shown in the mechanical drying done at 50°C after every drying technique. Sun drying and mechanical drying when done at 70°C reduce the quality of the product. For the improvement of the quality parameters improved sun drying technique can be used instead of the normal sun drying technique.

4. PACKAGING AND STORAGE EFFECT ON THE QUALITY OF THE POWDER

Studies carried out by Chang and Kim (1976) to design a good suitable consumer size package from the flexible packaging material to pack 100g of the chilli powder. From all that of the studies conducted regarding the packaging and storage conclude that for the long term storage of the powder, physico-chemical changes can be prevented up to great extent by the use of aluminium foil laminate which offers maximum protection. Amber or black polyethylene, high density polyethylene and Saran/ Cello/ Saran poly laminate pouches are some of the suitable alternatives which can be used for the short term storage and for the good moisture and colour protection. According to Narayanan and Dordi (1998) the most important part of the processing and preservation is packaging. Packaging influences the physical and chemical changes directly. Most widely used food packaging material is plastic because of their quality of being light in weight, having good productivity, and can be transformed into any shape and colour and being recyclable. Klieber and Bagnato (1999) stated that best extension of shelf life can be given by the storage under nitrogen. Adding seed oil can produce rancid odour but can retard the colour loss whereas the addition of vitamin E can extend the shelf life. Packaging plays an important role in the stability of foods influenced by the factors which cause deterioration of the products was given by Sonneveld (2001). Rate and extent of nutrient loss and microbial activity is determined by the nature of the package of the product and the composition of air inside the package. Morais*et al.* (2001) studied that the storage time, presence of light and oxygen affects the overall decomposition rate of the pigment. Storage time is the most important deciding factor while the oxygen impact is lowest on the condition. Packaging material plays a vital role in maintaining the quality and shelf life of the product. Package is that interface between the food and the external environment which effects many of the

factors like that of the keeping quality of product, adding value to it, protection of the product and the buying decision of the consumer. Mohammed *et al.* (2017) conducted the experiments which evaluate the shelf life of PusaJwara green chilly by the effect of the packaging materials and storage conditions. Tray and sun dried powders stored under the temperatures of 37°C and 5°C and packed in High propylene and flexible packaging foil. Retention of shelf life, vitamin C and colour can be obtained by the packaging of the chilli powder in flexible packaging foil at the temperature storage of 5°C and quality can be extended up to 6 months without the use of synthesis preservatives. Studies carried out by CFTRI, Mysore were for the spice powders storage that are pepper, turmeric, cumin, coriander and chilli which was conducted by taking 100g capacity in flexible pouches at the accelerated storage conditions of 38°C, 92% RH and the standard conditions that were 27°C, 65% RH. Pouches for the short term storage for about 90 days which can be used are mono films of 200 gauge polypropylene or high density polyethylene. Easy availability, compatibility, light weight, hygienic machine ability, heat seal ability, printability and selective barrier properties are some of the properties due to which plastic are preferred as the packaging material.

5. CONCLUSION

This review study gives up the observation that factors like variety, drying temperatures and harvesting conditions which influence the colour retention in the powdered form of chillies. Retention of the red colour of chilli can be achieved by the addition of ascorbic acid which ultimately checks the growth of microorganism and also enriches the vitamin C content in the chilli. Moisture levels with 14% are good for the colour stability and the prohibition of pigment destruction. High moisture content of 18% results in the microbial growth, caking and the non-enzymatic browning. For maintaining the keeping quality of the powder, powders need to be stored under cool conditions or in the dark at 37°C for the accelerated shelf life. Grinding done by the stone mill or hammer mill gives the equal quality powder and also do not influence the colour stability. Materials like laminates of cello/poly, metallised polyester/poly and paper/foil/poly are suitable for the long term storage conditions with the shelf life of over 200 days, one year and over one year respectively. For the best storage extension of the product, storage under nitrogen can be used.

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