Abstract

The present study was carried out to reveal the quality assessment of the chilli powder. The samples collected from market used in this investigation were commercial brand of chilli powder in Bangladesh. The quality parameters of moisture content, ash content, acid soluble ash content, refractive index, volatile fat were assessed which are directly related to quality, processing technique, storage condition, packaging, microbial load of chilli powder. The moisture content and ash content of chilli powder were about 4.40 - 6.00% and 5.28 - 6.19% respectively. Then microbiological tests such as TPC, mold count, coliform count, and salmonella were accomplished. Total mold count was found ranged from 1.0 x 10^6 to 3.1 x 10^7. Coliform was also detected, where all samples were free from Salmonella.

Keywords: Chilli powder; Volatile fat; Acid insoluble ash; Moisture content; Mold count; Coliform count

Abbreviations: CFU : Colony Forming Unit; G = Gram; TPC: Total Plate Count; PCA: Plate Count Agar

Introduction

Chilli (Capsicum annuum L.) is one kind of vegetable belonging to the family of Solanaceae. Chillies are cultivated in all Asian countries, large parts of Africa, U.S.A. and Southern Europe [1]. Chilli is generally found to be used in three forms, namely, as fresh green chillies, red chilli powder and raw red [2]. Chilli powder is prepared from ripe chilli. It is an important spice used as flavorings or condiments, in the tropics and subtropics and an indispensable item in the kitchen for every day cooking in Bangladesh. Chilli is dried to make chilli powder and to store it for both short and long term storage. The most important quality characteristics in chilli are the color and pungency. The red color of chilli is mainly due to carotenoid pigments [3-5].

To improve the quality of dried chili, industrial dryers are used to decrease the drying time and provide uniform and hygienic processing conditions. However, drying chilli with high temperatures leads to the loss of volatile compounds, nutrients and color [6,7]. Chillies have a relatively low volatile content, which is dependent upon species and stage of maturity. The eventual volatile content of the dried powder, however, may be lower and is dependent upon the drying procedure, the duration and condition of storage [8].

Color deterioration in chilli powder has been attributed to oxidation of carotenoid pigments which is greatly influenced by moisture content, storage, temperature, atmosphere and light [9]. The moisture content of the chilli powder appears to be critical for color retention during storage. Lower level of moisture leads to the color bleach while at higher levels there was darkening by browning reactions but there was no changes in carotenoid content [10]. High moisture content helps in survival and growth of the Mold [11].

Warm and humid condition is favorable for microbial growth. For this reason spices are easily contaminated by pathogenic microorganisms [12]. Powder needs storage under cool conditions and out of light [13]. Chilli powder shall be free from Mold growth, living or dead insects, insect fragments and rodent contamination [14].

It is essential to reduce the moisture content and provide aeration to the chillies after harvesting to prevent the development of micro-flora and subsequent loss of quality or total spoilage [15]. Many agricultural commodities such as cereals, oil seeds, dry fruits and spices have been reported to be contaminated with toxigenic moulds and aflatoxin under faulty storage conditions [16]. Chillies are reported to be contaminated with moulds and their toxic metabolites and Aspergillus flavus the predominant mold on chilli samples in several cases [17].

Materials and Methods

Moisture content

The moisture content of the chilli powder was determined by hot air oven method [18]. About 5 g of the chilli was weighed into a weighed moisture box and dried in an oven at 100 ± 1°C for 16 hours and cooled in a dessicator. The weight of the dried sample was recorded. The moisture content of the sample was calculated...
Volatile fat Content of all different commercial brand samples were relatively higher ranging from 1.6% to 2.0% being lowest for sample 1 and highest for sample 3 (Table 1). Chilli powder usually contains less than 0.5% of volatile oil [8]. The variations in fat contents might be due to difference in treatments, preparation and drying methods employed.

Microbiological parameters of chili powder

Total Plate Count, Mold count, Coliform count and Salmonella were tested for microbial assessment of chilli powder. These tested were done by using PCA, Petri-dish, Incubator, Peptone water. Sample Tested by Pour Plate Technique. All tested accomplished by following standard of FDA, Philippines, 2013-010 [21].

Results and Discussion

Moisture Content of four different commercial brand of chilli powder was ranged from 4.40% to 6.00% being lowest for sample 1 and highest for sample 4 (Table 1). The results were more or less similar to those reported by Krishnamurthy and Natarajan [9] who observed that the moisture content of chilli powder should be in the range of 8-10% per 100 gm. Mahadevaih et al. [22] found that moisture content higher than 15 percent in chilli powder was critical with respect to mould growth. Similar observations were also made by Naik et al. [23]. According to Indian Standard, maximum moisture content of chilli powder is 11.0% [14].

Ash content ranged from 5.28% to 6.19% being lowest in sample 3 and highest in sample 2 (Table 1). All samples satisfied Bangladesh Standard (<8.5%) for ash content in chilli powder [24]. According to Indian Standard, maximum ash content of chilli powder is 8.0% [14]. The results were more or less similar to those reported by Raina & Teotia [25] who noticed ash content ranging from 4.53 to 7.39 % in chilli powder.

All samples satisfied Bangladesh Standard (<1.5%) for acid insoluble ash content in chilli powder [24]. According to Indian Standard, maximum value of acid insoluble ash content of chilli powder is 1.3% [14]. Refractive Index of sample 3 is different from other samples. It is used to check oxidation and to determine the degree of saturation.

Volatile fat Content of all different commercial brand samples were relatively high ranging from 1.6% to 2.0% being lowest for sample 1 and highest for sample 3 (Table 1). Chilli powder usually contains less than 0.5% of volatile oil [8]. The variations in fat contents might be due to difference in treatments, preparation and drying methods employed.

The microbial load of chilli powder samples collected for different brand in Bangladesh was summarized in Table 2. Total Plate Count was found ranged from $2.3 \times 10^5$ to $5.7 \times 10^5$ being higher for sample 4, where reference value for Bangladesh is $1.0 \times 10^3$ cfu/g. Total mold count was found ranged from $1.0 \times 10^1$ to $3.1 \times 10^1$. The results were more or less similar to those reported by Tripathi et al. [11], who noticed mold count at initial days of incubation was $4.2 \times 10^1$ cfu/g.

Coliform bacteria were found in one sample which is higher than normally followed in Bangladesh ($1.0 \times 10^5$ cfu/g). According to Indian Standard, Salmonella in chilli powder must be absent [14]. All samples of our study were free from Salmonella. Gallo et al. [26] reported that faulty food handling techniques especially storage of food at improper temperature for long periods of time has been identified as one of the microbial proliferation in contaminated food. The production of these spices by some manufacturer may be under unhygienic environment. The spices
may also not be sufficiently dried or contaminated raw materials may be added or final products may be manually packaged. These factors will contribute to the high microbial counts obtained from these products.

Table 1: Quality parameters of chilli powder

| Sample name | Moisture Content (%) | Ash Content (%) | Acid Insoluble Ash Content (%) | Refractive Index (%) | Volatile Fat Content (%) |
|-------------|----------------------|-----------------|--------------------------------|----------------------|-------------------------|
| Sample 1    | 4.4                  | 5.78            | 1.3                            | 43.6562              | 1.6                     |
| Sample 2    | 5.56                 | 6.19            | 1.4                            | 48.7872              | 1.7                     |
| Sample 3    | 5.88                 | 5.28            | 1.3                            | 22.1232              | 2                       |
| Sample 4    | 6                    | 5.95            | 1.4                            | 47.6345              | 1.8                     |

Table 2: Microbiological parameters of chili powder.

| Sample name | TPC (cfu/g) | Mold Count (cfu/g) | Coliform Count (cfu/g) | Salmonella (cfu/g) |
|-------------|-------------|--------------------|------------------------|-------------------|
| Sample 1    | 4.9×10³     | 3.1×10³            | Nil                    | Nil               |
| Sample 2    | 2.3×10³     | 2.3×10³            | Nil                    | Nil               |
| Sample 3    | 5.1×10³     | 1.0×10³            | 1.8×10³                | Nil               |
| Sample 4    | 5.7×10³     | 2.0×10³            | Nil                    | Nil               |

Conclusion

From the performed chemical and microbiological test for commercial brand of chilli powder we found that brand products don’t match the all quality parameters and don’t follow the standard while manufacturing their products that ultimately lead to bad quality products and their consumption lead to various diseases. Chilli powders are high in bacterial count addition with high mold count.

It was concluded that spices may be high risk products as it contained many pathogenic bacteria, Coliform and mould. Packed branded chilli powder samples were less contaminated, so it is clear that the unpacked local spices may be highly contaminated with microorganisms. Therefore, more studies are necessary to find out the ways of contamination and proper preparation processing. Aseptic techniques at all stages of production and processing must be ensured to prevent contamination and quality of chilli powder.

Acknowledgement

The Modern Food Testing Laboratory, Chittagong City Corporation, provided all types of support and arrangement for this study.

References

1. Sastri BN (1992) The Wealth of India. A Dictionary of Indian Raw Materials and Industrial Products 6: 218-264.
2. Elias SM, Hossain MI (1984) Chili Cultivation in Bangladesh. Research Report, Agricultural Economics Division, Bangladesh Agricultural Institute, Gazipur, India.
3. Hossain MA, Bala BK (2007) Drying of hot chilli using solar tunnel drier. Solar Energy 81: 85-92.
4. Howard LR, ST Talcott, CH Brenes, B Villalon (2000) Changes in phytochemical and antioxidant activity of selected pepper cultivars (Capsicum species) as influenced by maturity. J Agric Food Chem 48(5): 1713-1720.
5. Topuz A, F Ozdemir (2007) Assessment of carotenoids. Capsaicinoids and ascorbic acid composition of some selected pepper cultivars (Capsicum annuum L) grown in Turkey. J Food Compos Anal 20: 596-602.
6. Kaleemullah S, R Kailappan (2006) Modelling of thin-layer drying kinetics of red chillies. J Food Eng 76(4): 531-537.
7. Di Scala KC, GH Crapiste (2008) Drying kinetics and quality changes during drying of red pepper. LWT-Food Sci Technol 41(5): 789-795.
8. De AK (2003) Capsicum: The Genus Capsicum. Taylor and Francis group, CRC press, New York, USA, 296.
9. Krishnamurthy K, Natarajan CP (1973) Color and its changes in chillies. Indian Food Packer, p.39-44.
10. Kanner J, Harel S, Palevitch D, Ben-Gera I (1977) Color retention in sweet red paprika (Capsicum annuum L) powder as affected by moisture contents and ripening stage. J Food Technol 12(1): 59.
11. Tripathi S, Mishra HN (2009) Nutritional Changes in Powdered Red Pepper upon In Vitro Infection of AspergillusFlavus. Brazilian Journal of Microbiology 40: 139-144.
12. Parveen S, Das S, Begum A, Sultana N, Hoque, et al. (2014) Microbiological quality assessment of three selected spices in Bangladesh. International Food Research Journal 21(4): 1327-1330.
13. Klieber A, Bagnato A (1999) Color stability of paprika and chilli powder. Food Australia 51(12): 592-596.
14. BIS (2010) Indian Standard Spices and Condiments-Chillies. Whole and Ground (Powdered)-Specification (3rd Revision). ICS 67.220.10.
15. Satishkumar, Karthik SK, Basamma KA (2015) Study of Different Physico-Chemical Properties of Byadagi Chilli Powder. International Journal of Tropical Agriculture 33(2): 559-564.

16. Reddy SV, Kiranmayi D, Umareddy M, Thirumala Devi, K Reddy (2001) Aflatoxin B1 in different grades of chillies (Capsicum annuum) in Indian as detected by indirect competitive ELISA. Food Addit Contam 18(6): 553-558.

17. Scott PM, Kennedy BPC (1973) Survey of ground black, white and capsicum peppers for aflatoxins. J Assoc Agric Chem 56: 1452-1457.

18. AOAC (1995) Official Methods of Analysis of AOAC. (16th edn), Arlington, Virginia, USA.

19. AOAC (1980) Official Methods of Analysis (13th Edn), Association of Official Analytical Chemists, Arlington, Virginia, USA.

20. AOAC (2000) Official Methods of Analysis of AOAC. (17th edn), Arlington, Virginia, USA.

21. FDA (2013) Food and Drug Administration. Philippines.

22. Mahadevaih B, Chang KS, Balasubrahmanyam N (1976) Packaging and storage studies on dried ground and whole chilies (Capsicum annuum L) in flexible consumer packages. Indian Food Packer 33(6): 33-40.

23. Naik PJ, Nagalakshmi S, Balasubramnyam N, Dhanaraj S, Shankaracharya NB (2001) Packaging and storage studies on commercial varieties of Indian chilies (Capsicum annuum L). J Food Sci Technol 38(3): 227-230.

24. Raina, Teotia MS (1985) Evaluation of chillies (Capsicum annuum L) grown in Jammu and Kashmir. Indian Food Packer 39: 6-10.

25. BDS (1985) Bangladesh Standard of Spice Product. Bangladesh Standard Testing Institutions, Bangladesh.

26. Gallo G, Berzzen R, Caltai N, Recchia S, Orefici G (1992) An outbreak of group a food-borne Streptococcal pharyngitis. European Journal of Epidemiology 8(2): 292-297.