Assessing the Quality Parameters of Red Chillies in Different Stages of Food Chain

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Abstract-The baseline information's were collected regarding the red chillies from the farmers of Tamilnadu. Aflatoxins (B1, B2, G1 and G2) were analysed in the TNAU variety of red chillies K 1, K 2, CO 1, CO 2 and PMK1 in the different stages of food chain. Moisture, iron and vitamin C were highest in the fresh red chillies of PMK1 variety. The aflatoxin content was below limit of quantification in the fresh and dried chillies at the consumer end retail shop. The moisture content were ranged from 4.21 ± 0.38 to 8.90 ± 0.85 found in all the five selected samples and the microbial load such as TFC and mold were observed in different stages of food supply chain. The results of this study that the physical sorting regarding colour, size and shape can be used to reduce the AFs contamination of chilli offered for human consumption. Physical sorting can be successfully applied as a rapid, safe and cost effective solution to the problem in conjunction with non-destructive to the nutritional values, however, complete elimination of AFs is not possible and also limit the below permissible level. In order to prevent the hazards associated with the fungal contamination, number of procedures, such as, controlling moisture and temperature, packing, storage, etc., can reduce AFs from red chillies and chillies products.

Keywords : AFs (Aflatoxin, Food supply chain, TFC – Total Fungal Colonies.

I. INTRODUCTION

Chilli is one of the most important commercial crops of India. It is grown almost throughout the country. There are more than 400 different varieties of chillies found all over the world. It is also called as hot pepper, cayenne pepper, sweet pepper, bell pepper, etc. It's botanical name is "Capsicum annuum". The world's hottest chilli "Naga Jolokia" is cultivated in hilly terrain of Assam in a small town Tezpur, India. Different varieties are grown for vegetables, spices, condiments, sauces and pickles. Chilli occupies an important place in Indian diet. It is an indispensable item in the kitchen, as it is consumed daily as a condiment in one form or the other. Among the spices consumed per head, dried chilli fruits constitute a major share. Currently, chillies are used throughout the world as a spice and also in the making of beverages and medicines. If some varieties of chillies are famous for red colour because of the pigment 'capsanthin,' others are known for biting pungency attributed to 'capsaicin.' India is the only country which is rich in many varieties with different quality factors. Chillies are rich in vitamins, especially in vitamin A and C. They are also packed with potassium, magnesium and iron. Chillies have long been used for pain relief as they are known to inhibit pain messengers, extracts of chilli peppers are used for alleviating the pain of arthritis, headaches, burns and neuralgia. It is also claimed that they have the power to boost immune system and lower cholesterol. They are also helpful in getting rid of parasites of gut.

II. PROPOSED METHODOLOGY

1.1. Baseline Information

The baseline information's were collected from the farmers of Madurai, Ramanathapuram, Virudhunagar and Dindigul districs of Tamilnadu. Based on the baseline information the red chillies varieties such as K 1, K 2, CO 1,CO 2 and PMK1 were selected for this study.

1.2. Reagents

All the chemicals and solvents used in this study were of analytical grade. Crystalline AFs standards were purchased from Sigma-Aldrich. The crystals of AFs (Aflatoxins) were diluted, using benzene-acetonitrile (98:2 v/v) to obtain a concentration of 10µg/ml (stock solution). The concentration of the prepared solution was adjusted, using the spectrophotometer at a wave-length of the absorption maxima close to 350nm. The suitable concentration, used for thin layer chromatography (TLC), was 1.0µg/ml. Precoated TLC plates of Silica gel 60 (layer thickness 0.25mm, 20cm x 20cm) on glass or aluminium, without fluorescent indicator, were purchased from E. Merck (Dramstadt, Germany).

1.3. Physical Method for Chillies Sorting

Chillies samples were subjected to physical sorting to remove midget/dwarfed, damaged/ broken and discoloured (brownish grey) chillies. Furthermore, chillies off-standard by size (< 1.50cm) or weight (< 0.50g) were removed. The following methods were used.

1.3.1. Colour Sorting

The discoloured (brownish grey) chillies were removed as compared to standard coloured (bright red) chillies. The colour sorting reduced the probability of having high AF

contamination. The selected chillies were then preceded for size sorting.

1.3.2. Size Sorting

The small chillies (< 1.50 cm) seemed to be liable for deterioration were removed. Moreover, the damaged, broken and the midget/dwarfed red chillies were also separated from the standard size chillies.

1.3.3. Weight Sorting

Below 0.50g chillies were rejected from the standard size. Finally, dust and dirt were removed from the examined chillies batches.

1.3.4. Proximate analysis of red chillies:

Moisture

The samples of red chillies were analyzed for the moisture content according to their respective methods described in AACC (2000).

Ascorbic acid (Vitamin C)

The dye factor was found by titrating standard ascorbic acid (0.1mg in ml) against 2,6- dichlorophenol indophenols dye solution. About 5 g of sample was extracted with 4 per cent oxalic acid and was made upto 100 ml with oxalic acid. An aliquot was titrated against standard dye solution. The amount of ascorbic acid present in the sample was calculated and expressed as mg 100g-1 (AOAC, 1997).

1.3.5. Aflatoxin in red chillies

Sample extraction and clean-up:

For analysis of aflatoxin in red chillies, sample extraction and clean up was done as described by Richard (2000). A 25 g finely ground homogeneous sample was taken into 250 mL conical flask and 100 mL solvent (acetonitrile: water, 84:16) was added. The flasks were placed in a horizontal shaker for 1hour. Romer MycoSep column 228 (Romer Laboratory Inc., USA) was used for clean up and residue was evaporated by nitrogen gas. After drying, samples were re-dissolved in 300 µL mobile phase (acetonitrile: methanol: water; 1:1:2) for High Performance Liquid Chromatography (Alberts et al., 2006). The concentration of aflatoxins in each sample was expressed as µg kg -1.

1.3.6. High Pressure Liquid Chromatographic (HPLC) analysis:

The HPLC system (Perkin Elmer 200 Series, USA) was used for analysis of aflatoxin in red chillies. The specifications of the HPLC were: the Series 200 UVVis detector with wavelength fixed at 365 nm; Total Chrom, Chromatography Data System (CDS) software. The analysis was carried out by following the conditions: column temperature 30oC, flow rate of mobile phase; 1 mLmin-1. All analyses were performed isocratically using degassed HPLC grade acetonitrile: methanol: water (1:1:2, v/v/v) (Merck, Germany) as a mobile phase. The reverse-phase chromatographic column (Discovery C (250 x 4.6 mm, 5 µm), Supelco, Bellefonte, PA, USA) was used for the detection of aflatoxins (B1, B2, G1 and G2). During analysis of samples through HPLC, a standard solution was injected after every 10 samples in order to assess the retention time verification and instrument calibration.

1.3.7. Statistical analysis

ANOVA test was applied for making comparisons. The CD value less than 0.05 were considered statistically significant.

III. EXPERIMENTAL RESULTS

Baseline information

The baseline information was collected from the farmers of Madurai, Ramanathapuram, Virudhunagar and Dindigul districs of Tamilnadu. Based on the baseline information the red chillies varieties such as K 1, K 2, CO 1,CO 2 and PMK1 were selected for this study.

Chemical characteristics of fresh and dried red chillies

Chemical characteristics such as moisture, iron and vitamin C were analysed in the selected varieties of fresh and dried chillies such as K1, K2, CO1, CO2 and PMK1 and the values are given in the table 1 and 2.

Table 1. Chemical characteristics of fresh red chillies

Varieties	Moisture (g)	Iron (mg)	Vitamin C(mg)
K1	84.2	3.9	101.0
K2	86.1	3.2	102.0
CO1	87.4	3.4	100.0
CO2	87.0	3.9	102.0
PMK1	88.2	4.1	103.0

	SED	CD(0.05)	CD(0.01)
Moisture	0.8082	1.8008	2.5316**
Iron	0.0347	0.0773	0.1099**
Vitamin C	0.9484	2.1131	3.0058*

Out of the five varieties of red chillies, PMK1 had highest level of moisture (88.2g), iron (4.1mg) and vitamin C (103.1mg) in the fresh red chillies. The differences in the moisture, iron and vitamin C content between the different

varieties of fresh chillies were found to be statistically significant. Kim et al., (1982) reported that the physical and chemical qualities of all the chilli dried with different drying methods were compared to the fresh chilli. The initial average moisture content and water activity of fresh chilli were 85.15% and 0.99, respectively. The average moisture contents of all dried chilli were 11% wb and water activities varied between 0.51 and 0.68. The moisture content of chilli is strongly correlated with the stability of ascorbic acid and pigment as well as any hygiene problems.

Table 2. Chemical characteristics of dried red chillies

Varieties	Moisture (g)	Iron (mg)	Vitamin C(mg)
K1	9.3	1.5	44.1
K2	9.6	1.5	44.3
CO1	9.3	1.5	44.0
CO2	9.4	1.2	44.2
PMK1	9.5	1.8	44.9

	SED	CD(0.05)	CD(0.01)
Moisture	0.0879	0.1959	0.2787*
Iron	0.0141	0.0314	0.0447**
Vitamin C	0.4135	0.4213	1.3106*

** Highly significant and * significant

The higher amount of moisture and vitamin C content of dried red chilies were observed in K2 variety. However iron was higher in PMK1 variety. Howard et al. (1994) reported that 75% of ascorbic acid in red chilli was lost during drying, with the final content of ascorbic acid being in a range from 12.0 to 44.4 mg/100 g.

Table 3. Moisture and Aflatoxins (ppb on dry weight basis) content red chillies

Varieties	Moisture content of red chilies	Aflatoxins (µg/kg)			
		B1	B2	G1	G2
K1	4.40 ± 0.75	2.24	1.35	1.86	2.3
K2	5.56 ± 0.75	2.14	1.32	1.83	2.28
CO1	5.88 ± 1.18	1.9	1.62	1.93	2.55
CO2	4.21 ± 0.38	1.94	1.67	2.31	2.61
PMK1	6.20 ± 0.38	1.89	1.92	2.04	2.12

However in the sun dried samples the aflatoxin was detectable as shown in table 3 and found to be below the permissible limits 5ppb (parts per billion).

Table 4. Moisture and microbial load (ppb on dry weight basis) of red chillies (producer chillies)

Varieties	Moisture content of dried red chilies	Microbial load (average)	
		TFC (cfu/g)	Mold (cfu/g)
K1	8.00 ± 0.22	7.1×10^3	4.0×10^3
K2	8.80 ± 0.62	7.4×10^3	4.0×10^3
CO1	8.01 ± 1.12	7.9×10^3	4.3×10^3
CO2	7.21 ± 0.14	6.8×10^3	3.7×10^3
PMK1	8.90 ± 0.85	7.9×10^3	4.5×10^3

The table 4 showed that the moisture content were ranged from 7.21 ± 0.14 to 8.90 ± 0.85 found in all the five selected samples and the microbial load such as TFC ranged from 6.8 × 103 to 7.9× 103 and mold were 3.7× 103 to 4.5× 103 respectively.

Table 5. Moisture and microbial load (ppb on dry weight basis) of red chillies (Retailer - cold storage)

Varieties	Moisture content of dried red chilies	Microbial load (average)	
		TFC (cfu/g)	Mold (cfu/g)
K1	4.40 ± 0.75	4.2×10^3	2.0×10^3
K2	5.56 ± 0.75	4.9×10^3	2.3×10^3
CO1	5.88 ± 1.18	5.1×10^3	2.5×10^3
CO2	4.21 ± 0.38	2.3×10^3	1.0×10^3
PMK1	6.20 ± 0.38	5.7×10^3	3.1×10^3

The table 5 showed that the moisture content were ranged from 4.40 ± 0.75 to 6.20± 0.38 found in all the five selected samples and the microbial load such as TFC ranged from 2.3 × 103 to 5.7× 103 and mold were 1.0× 103 to 3.1× 103 respectively. Toontom et al (2012) studied the effects of drying methods in chilli, such as sun drying at 37oC, hot air drying at 60oC and freeze drying, on the quality of dried Chee fah chilli (Capsicum annuum Linn. var. acuminatum Fingarh.). The quality parameters

were moisture content, colour (L*, a*, b* values), ascorbic acid content, capsaicin content, volatile flavour and sensorial description were assessed.

Table 6. Moisture and microbial load (ppb on dry weight basis) of red chillies (wholesalers)

Varieties	Moisture content of dried red chilies	Microbial load (average)	
		TFC (cfu/g)	Mold (cfu/g)
K1	6.51 ± 0.12	5.1×10^3	3.2×10^3
K2	6.92 ± 0.14	5.3×10^3	3.3×10^3
CO1	6.25 ± 0.85	5.0×10^3	3.1×10^3
CO2	6.93 ± 0.38	5.2×10^3	6.2×10^3
PMK1	7.27 ± 0.64	6.2×10^3	6.8×10^3

The table 6 showed that the maximum moisture content was found in PMK1 (7.27 ± 0.64) and minimum 6.25 ± 0.85 and the microbial load such as TFC maximum was observed in PMK1 6.2× 103 and 6.8× 103 in mold respectively.

Table 7. Moisture and microbial load (ppb on dry weight basis) of red chillies (retail shop red chillies)

Varieties	Moisture content of dried red chilies	Microbial load (average)	
		TFC (cfu/g)	Mold (cfu/g)
K1	7.11 ± 0.13	6.2×10^3	3.3×10^3
K2	7.14 ± 0.22	6.5×10^3	3.4×10^3
CO1	7.06 ± 0.14	5.9×10^3	3.1×10^3
CO2	7.19 ± 0.48	6.8×10^3	6.5×10^3
PMK1	7.16 ± 0.79	6.2×10^3	6.4×10^3

The table 7 showed that the moisture content were ranged from 7.06 ± 0.14 to 7.19 ± 0.48 found in all the five selected samples and the microbial load such as TFC maximum was observed in PMK1 (6.8× 103) and 6.5× 103 in mold respectively.

Critical level of moisture content in red chillies

The “optimum zone of moisture contents for fungal development” that lies between 12% and 25% MC at 25°C [25]. The results, however, indicated that the post-harvest period between 0 to 15 days should be considered as critical for the development of aflatoxins in chilies. Hence, drying of red chillies reduce the moisture content to 12%. At this moisture content the fungal growth is arrested which is turn to inhibit aflatoxin development.

IV. CONCLUSION

The results of this study revealed that the physical sorting such as colour, size and shape can be used to reduce the AFs contamination of chillies. Physical sorting can be successfully applied as a rapid, safe and cost effective solution to the problem in conjunction with non-destructive to the nutritional values, however, complete elimination of AFs is not possible and also limit the below permissible level. In order to prevent the hazards associated with the fungal contamination, number of procedures, such as, controlling moisture and temperature, packing, storage, etc., can reduce AFs from red chillies and chillies products.

FUTURE SCOPES

• It will useful for consumer to identify which is affected by aflatoxin or not affected.

• Consumer know the below limit of quantification of the aflatoxin level.

REFERENCES

[1] AACC, 2000. Approved Methods of American Association of Cereal Chemists, 15th Edn. Arlington. USA.

[2] Richard, J., 2000. Mycotoxins- an overview, vol. 1, pp: 1-48, 1st Edn, Romer Laboratories Inc., 1301-Stylemaster Drive, Union, Mo 63084-1156, USA.

[3] Alberts, J.F., Y. Engelbrecht, P.S. Steyn, W.H. Holzapfel and W.H.Van Zyl, 2006. Biological degradation of aflatoxin B by Rhodococcus erythropolis cultures. 1Int. J. Food Microbiol., 109: 121-126.

[4] Kim, D. Y., Rhee, C. O. and Shin, S. C. 1982. Changes in colour of red pepper during drying and milling. Journal of the Korean Chemical Society 25: 1-7.

[5] Howard, L. R., Smith, R. T., Wagner, A. B., Villalon, B. and Burns, E. E. 1994. Provitamin A and ascorbic acid content of fresh pepper cultivars (Capsicum annuum) and processed jalapeños. Journal of Food Science 59:

[6] Toontom, N., Meenune, M. and Posri W. 2012. Consumer preference on flavour profiles and antioxidant information of a Thai chili paste. British Food Journal 112(11): 1252-1265.