THE INTERNATIONAL JOURNAL OF SCIENCE & TECHNOLEDGE

Quality Assessment of Processed C*urcuma Longa* (Turmeric) Powder for Microbial Contamination and Physico-Chemical Properties

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Abstract:
The present study was designed to assess the quality of turmeric powder procured from retail markets of Tamil Nadu state, India. Turmeric powder is widely used in Indian cuisines; therefore their compliance with the Food Safety Standards Authority of India (FSSAI) specification is important. The physico-chemical properties like moisture content, ash content and bulk density were analysed. The sensory characteristics like colour, flavour, taste, texture and overall acceptability were analysed. Adulterants like metanil yellow and saw dust were analysed. The microbial flora of the samples was determined for some specific organisms like Salmonella species, E. coli and fungus (yeast and mould). There were slight variations in the physico-chemical properties among the samples but it was within the recommended levels of the FSSAI standard. Sensory characteristics of the samples were scored with 8 in the hedonic scale for the overall acceptability. Adulterants (metanil yellow and saw dust) were absent in the samples. Though Salmonella species, E. coli were absent, fungal (yeast and mould) contamination was detected which is not recommended by the FSSAI. Therefore it is concluded that except the microbial contamination, the sample complied with the FSSAI specifications.

Keywords: *Quality assessment, physico-chemical, sensory properties, adulterant, microbial contamination*

1. Introduction

Curcuma longa (turmeric) belongs to the ginger family, is a commonly used spice in Middle Eastern countries and other regions of Asia. Curcumin is a yellow pigment extracted from rhizome of the species *zingiberaceae* (Reema *et al,* 2006). It is a biologically active component with functional properties like antifungal, antioxidant, anti-inflammatory, anti-diabetic, anti-cancer, anti-bacterial, etc., (Singh *et al.,* 2012).Traditionally, turmeric powder is used as a colouring agent and flavouring agent in various cuisines. It is used as a prime ingredient in the curry powder and also used in various combinations with other spices (Reema *et al.*, 2006). Herbs and spices may contain pathogens like *Salmonella spp., Escherichia coli,* endospore forming and toxin producing pathological bacteria which may get introduced into the food, causing spoilage and potential risk to public health. Microbial contamination other than bacteria, yeast and moulds may create serious problems due to mycotoxin production (Kosalec *et al*., 2009). Adulterants like metanil yellow (an artificial colour) is used to intensify the colour of the turmeric powder and saw dust are added to increase the quantity of the turmeric powder for gaining more profit. The increase in the food borne illness had created an alarm in the food sector. Thus, food safety is the key solution for this global issue. Global awareness has intensified for the improvement of food safety by implementing standards. Government of India enacted a food law called Food Safety and Standards Act (FSSA), 2006 (Sudershan *et al*., 2009) and an autonomous authority called Food Safety And Standard Authority of India (FSSAI) sets standards for various food products to match up with the global standards and to meet the requirements of our country.

This study was undertaken to assess the physico-chemical properties, sensory properties, adulterants and microbial contaminants according to the FSSAI specification for the samples procured from retail markets of Tamil Nadu state, India.

2. Materials and methods

2.1. Sample Collection

Commercially available 20 different samples of turmeric powder from retail markets of Tamil Nadu were analyzed in triplicates for their physico-chemical properties, sensory properties, adulterants and microbial contaminants. For microbial assessment, samples were taken aseptically immediately after opening the sealed packets. Then the packets were sealed again and were stored in refrigerator in clean and hygienic conditions.

2.2. Physico-Chemical Properties

The moisture content and total ash were analyzed as per AOAC standard methods (AOAC, 1990). The bulk density of the sample was also determined (Ocloo *et al*., 2010).

2.3. Sensory Properties

The colours, texture, flavour, taste and overall acceptability of the turmeric powder was evaluated with the help of the sensory evaluation of the samples using the 9 point Hedonic scale. The 9 point Hedonic scale (Peryam, 1952) ranging from 9- extremely like, 5- neither like nor dislike, 1- extremely dislike was used.

2.4. Microbial Contamination

Samples of 25 gms each were taken randomly, mixed thoroughly and used triplicate samples of 1gm each for microbial colony study. The colony count of microbes like *E. coli, Salmonella* and mould were checked for their presence in the sample with the help of a differential microbial medium like Eosin Methylene Blue (EMB) agar, *Salmonella Shigella* (SS) agar and Potato Dextrose (PD) Agar. The serial dilution technique and pour plate method was used for the analysis (AOAC, 2005). The total plate count (TPC) was analysed for the dilutions of 10^{-1} and 10^{-2}.

2.5. Test for Adulterants

Test for saw dust: Sprinkle on water surface. The saw dust floats on the surface.

Test for metanil yellow (an artificial colour): A teaspoon full of turmeric powder was taken in the test tube and added with few drops of concentrated hydrochloric acid. Instant appearance of pink colour if disappears on dilution with water indicates the pure turmeric. If the colour persists, metanil yellow is present (FSSAI, 2012).

3. Results and discussion

3.1. Sensory analysis

The twenty samples were analyzed for their sensory properties like colour, flavour, texture and overall acceptability with the help of 15 people. Based on the difference in the intensity of colour from deep orange to yellow, four samples 2, 5, 13 & 17 having the bright yellow colour which was more appealing to eyes were scored as 8 in the hedonic scale. For the characteristic of flavour, five samples 3, 5, 15, 17 & 20 were scored as 7. Based on the pungent taste of turmeric, four samples 3, 7, 13 & 18 were scored as 8 and the texture, i.e. fine powder did not show any significant difference between the samples and for the overall acceptability of the samples 3, 5, 13 & 17 were scored as 8 in the hedonic scale. Inspite of the efforts to collect literature in this regard, no relevant literature could be collected.

3.2. Moisture content

The average percent of moisture (wet basis) in the samples was 11.004±0.65% w/w. (Figure 1). Kadam (2013) investigated and reported an average moisture content of 8.92±0.021% w/w and concluded that the samples were dried and stored properly. Insufficient drying favours the spoilage by fungus (yeast and moulds) and bacteria and makes possible the enzymatic destruction of the active principles (Mukharajee, 2002). Thus, the determination of moisture content is particularly important. The recommended level of moisture content in turmeric powder should not exceed 12% (Food Safety Standards Authority of India).

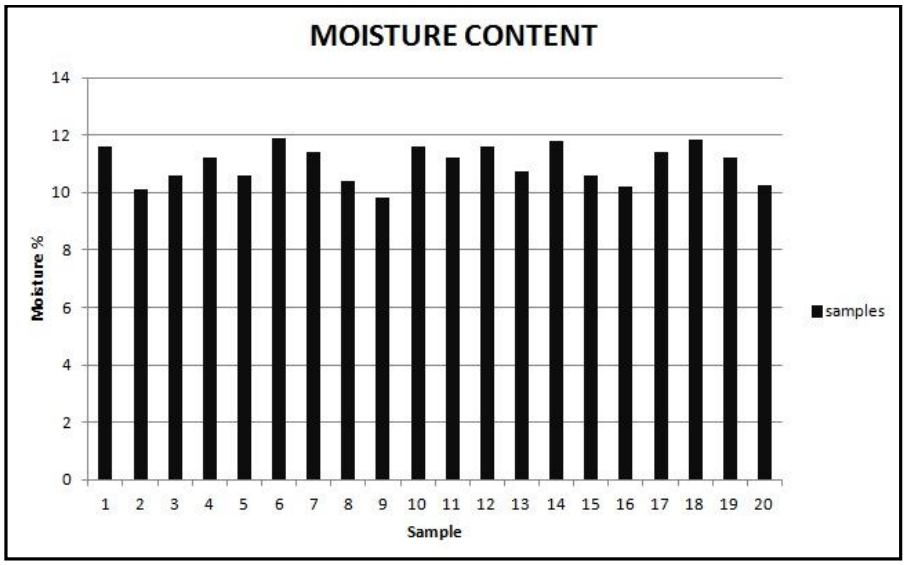

Figure 1: Moisture content of market samples (Number of sample, N=20)

3.3. Ash content

The average percentage of ash content was 8.04±0.50% w/w (Figure 2). The present result which signifies the quality and purity of the turmeric powder is in accordance with Kadam (2013) who investigated and reported an average ash content of 8.39±0.03% w/w and concluded that the purity of the samples was satisfying.

Ash content was less than the prescribed limit for all the samples and were within the recommended level of ash content in turmeric powder < 9% (FSSAI). The total ash is important in the evaluation of purity of samples, i.e. the presence or absence of foreign matter such as metallic salts or silica (Kumar *et al*., 2012).

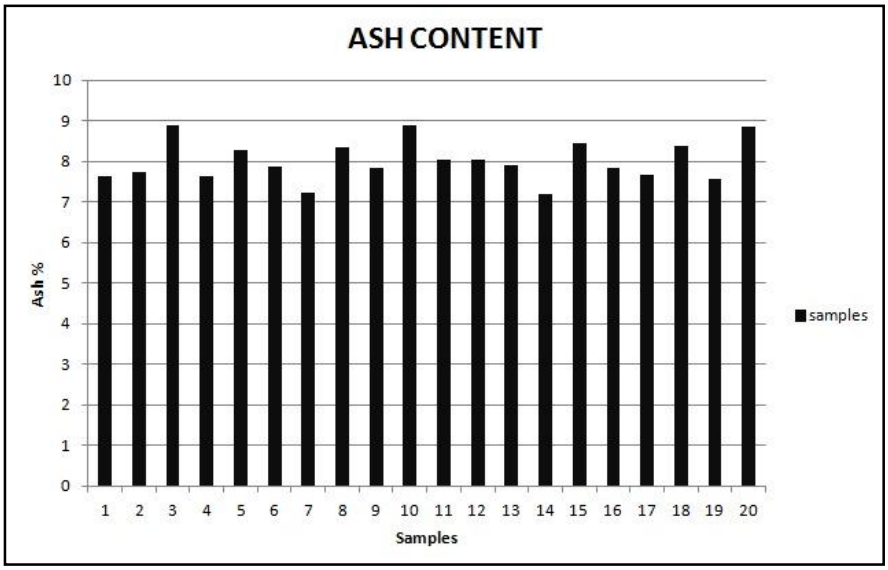

Figure 2: Ash content of market samples (Number of samples, N=20)

3.4. Bulk density

All the samples showed bulk density within the prescribed limit. The average percentage of bulk density was 0.61±0.02 g/cm^3 at a moisture content of 11% wet basis (Figure 3). Conversely, Barnwal (2014) investigated ground turmeric and reported an average bulk density of 0.48 g/cm^3 at a moisture content of 10% wet basis and concluded, that an increase in moisture content increases the volumetric expansion and therefore decreasing the bulk density of the sample. According to the FSSAI, the recommended level of bulk density in turmeric powder should not exceed 80%.

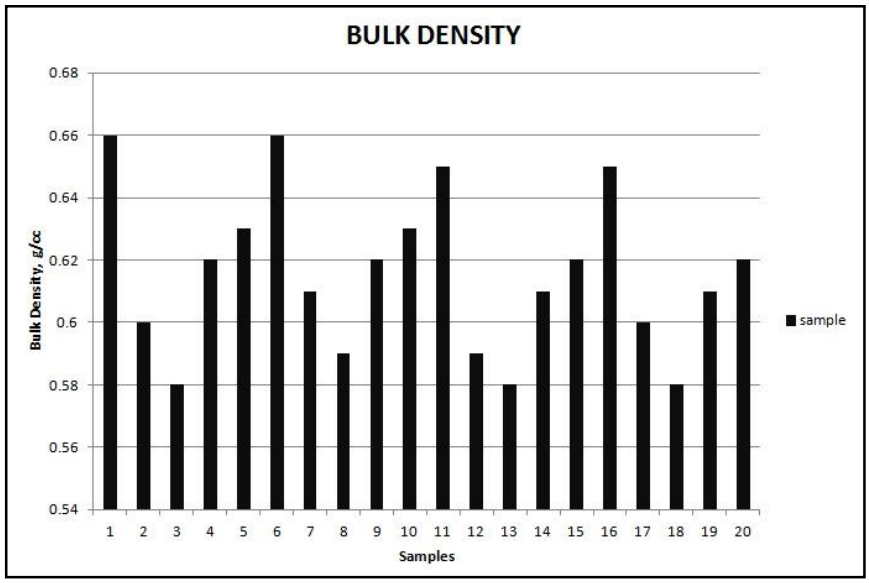

Figure 3: Bulk density of market samples (Number of samples, N=20)

3.5. Microbial quality evaluation

Fungal (yeast and mould) colonies were detected only in six samples 2, 6, 7, 10, 15 & 17 (Table 1). Thus, 30% of the samples were contaminated with fungus (yeast and mould). The samples were not detected with the pathogenic bacteria like *Salmonella spp.* and *E. coli* (Table 1). The present result though is in accordance with the FSSAI specification for *Salmonella spp.* and *E. coli* which should be absent in 25 gm of sample but regarding the fungal growth, which should not be detected in the sample, the samples analysed could not meet the standards. Praveen (2014) investigated 15 packed spices samples from local markets and reported that *E. coli* count and *Salmonella* count were not detected with the turmeric samples.

The highest mean plate count recorded was 122×10^{-1} cfu/g and 43×10^{-2} cfu/g. The lowest mean plate count was 29×10^{-1} cfu/g and 10×10^{-2} cfu/g (Table 2). According to FSSAI standard, the acceptable count was upto 40,000 cfu/g. Thus, the TPC was within the specified limit. Praveen (2014) investigated 15 packed spices samples from local markets and reported that the mean plate count was 8.18×10^{-2} cfu/g, which is also in concurrence with the present result.

Samples	Salmonella sp.		E.Coli		Fungus (yeast & molds)	
	Specification	Result	Specification	Result	Specification	Result
1	Negative	Absent	Negative	Absent	Negative in 25gm	Present
2	Negative	Absent	Negative	Absent	Negative in 25gm	Absent
3	Negative	Absent	Negative	Absent	Negative in 25gm	Present
4	Negative	Absent	Negative	Absent	Negative in 25gm	Present
5	Negative	Absent	Negative	Absent	Negative in 25gm	Present
6	Negative	Absent	Negative	Absent	Negative in 25gm	Absent
7	Negative	Absent	Negative	Absent	Negative in 25gm	Absent
8	Negative	Absent	Negative	Absent	Negative in 25gm	Present
9	Negative	Absent	Negative	Absent	Negative in 25gm	Present
10	Negative	Absent	Negative	Absent	Negative in 25gm	Absent
11	Negative	Absent	Negative	Absent	Negative in 25gm	Present
12	Negative	Absent	Negative	Absent	Negative in 25gm	Present
13	Negative	Absent	Negative	Absent	Negative in 25gm	Present
14	Negative	Absent	Negative	Absent	Negative in 25gm	Present
15	Negative	Absent	Negative	Absent	Negative in 25gm	Absent
16	Negative	Absent	Negative	Absent	Negative in 25gm	Present
17	Negative	Absent	Negative	Absent	Negative in 25gm	Absent
18	Negative	Absent	Negative	Absent	Negative in 25gm	Present
19	Negative	Absent	Negative	Absent	Negative in 25gm	Present
20	Negative	Absent	Negative	Absent	Negative in 25gm	Present

Table 1: Microbial quality evaluation of market samples (Number of Samples, N=20)

Samples	Total Plate Count (Cfu/g)	
	10^{-1}	10^{-2}
1	122	28
2	99	12
3	109	23
4	117	27
5	74	34
6	34	21
7	78	10
8	56	11
9	103	22
10	69	28
11	29	19
12	45	17
13	79	43
14	85	29
15	23	20
16	48	32
17	69	30
18	72	27
19	61	16
20	89	14

Table 2: Total Plate Count (Number of Samples, N = 20)

3.6. Adulterants

The rapid tests indicated that the samples were negative for metanil yellow and saw dust (Table 3), thus meets the specifications of FSSAI, which does not permit presence of both adulterants.

Sample	Specification	Saw Dust	Metanil Yellow
1	Negative	Absent	Absent
2	Negative	Absent	Absent
3	Negative	Absent	Absent
4	Negative	Absent	Absent
5	Negative	Absent	Absent
6	Negative	Absent	Absent
7	Negative	Absent	Absent
8	Negative	Absent	Absent
9	Negative	Absent	Absent
10	Negative	Absent	Absent
11	Negative	Absent	Absent
12	Negative	Absent	Absent
13	Negative	Absent	Absent
14	Negative	Absent	Absent
15	Negative	Absent	Absent
16	Negative	Absent	Absent
17	Negative	Absent	Absent
18	Negative	Absent	Absent
19	Negative	Absent	Absent
20	Negative	Absent	Absent

Table 3: Verification in the presence of adulterants (Number of samples, N= 20)

4. Conclusion

The samples were analyzed for different parameters to check its compliance with the FSSAI specification. Based on the results obtained, it was concluded that the turmeric powder samples comply with the specification of FSSAI with respect to physico-chemical, sensory properties, adulterants and the microbial contamination except fungal contamination. Therefore, Good Hygiene Practices and Good Manufacturing Practices should be followed during processing, storage and packaging of turmeric powder.

5. Acknowledgement
The authors gratefully acknowledge Dr. M. Vairamani, Dean, School of Bioengineering; we are also indebted to Pharmacovigilance Laboratory for Animal Feed and Food Safety (PLAFFS), Directorate of Centre for Animal Health Studies, Tamil Nadu Veterinary and lmhh Animal Sciences University (TANUVAS), Madhavaram Milk Colony, Chennai, Tamil Nadu.

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