Comparative Analysis of Crude Protein, Total Phenolic and Antioxidant Contents of Raw and Commercially Packed Turmeric and Red Chilies

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Authors’ contributions

This work was carried out in collaboration among all authors. Design of the study and statistical analysis were carried out by authors MRNA and MMHK. Authors MRNA and SI performed the wet lab experiments. All authors read and approved the final manuscript.

ABSTRACT

Background: Turmeric and red chili are the common spices used for cuisine preparation in Bangladesh. Commercially packed turmeric and red chili might have decreased nutrient contents compared to raw turmeric and red chili.

Aims: The study aimed to compare some of the nutrient values between the commercially packed and raw turmeric and red chili.

Methods: Commercially packed turmeric and red chili with different brand names (Radhuni, Tiger and Pran) and in raw turmeric and red chili were purchased from local market. Proximate analyses - dry matter (DM), crude protein (CP), crude fiber (CF) and mineral contents were performed. The total phenolics and total tannin contents were determined using appropriate methods.

Results: The proximate analysis results showed that both Radhuni (97.56 mg/g) and Tiger (97.28 mg/g) turmeric revealed significantly higher content of DM (p<0.001). No notable difference was observed in CP value. Crude fiber value displayed significantly highest value (p<0.001) in Tiger.
brand (4.96 mg/g) and the lowest in Radhuni brand (1.76 mg/g). Mineral content was significantly (p<0.05) highest in raw turmeric (9.97 mg/g). A significantly higher amount (p<0.001) of DM in packed chili was recorded. Tiger chili contained significantly higher amount of CP (6.02 mg/g) and CF (9.31 mg/g) while Radhuni contained the lower amount of CP (4.81 mg/g) and CF (2.48 mg/g). Raw chili had significantly higher amount of ash (13.24 mg/g). Examination revealed significant level (p<0.001) of total phenolics in acetone extracts of Tiger turmeric and chili powder. Significant amount of tannin was found in raw turmeric (33.89 µg/g; p<0.005); however, Pran brand of turmeric had the lowest amount of tannin (9.53 µg/g). Tannin content recorded in red chili was significantly (p<0.001) higher in commercially packed Tiger brand which was 16.57 µg/g compared to raw red chili (3.315 µg/g). Antioxidant analysis showed higher antioxidant activity in both raw turmeric and red chili powder.

**Conclusion:** Tiger brand turmeric ensures the standard measure, fiber and protein contents as well as the amount of phenolics and tannin.

**Keywords:** Turmeric; chilies; phenolics; tannin; DPPH.

1. **INTRODUCTION**

Spices are valued as ingredients of incense, embalming preservatives, perfumes, preservatives and medicines. These are inevitable items for cooking foods in Bangladesh. International Standards Organization (ISO) listed 107 varieties of spices in the World. There are about 27 varieties of spices grown in Bangladesh [1]. Traditionally, Bangladeshi food menus are spices dominated [2]. They blend food to extract the nutrients and bind them in a palatable form. These spices are used in different forms - whole, chopped, ground, roasted, sautéed, fried and as topping. For a very long time, all of these spices are used as freshly harvested or dried form. All of these spices have medicinal values as they are rich in phenolic compounds like capsaicinoids from chilies, curcuminoids from turmeric, piperine from black pepper, gingerols from ginger, eugenol from cloves, coumarin from cinnamon etc [3].

Turmeric (*Curcuma longa*)- the most commonly used spice in Bangladesh is highly rich in flavonoids, phenolic compounds, tannin and ascorbic acid [4,5]. Akter et al (2019) analyzed the antioxidant properties of more than 80 species of turmeric. These antioxidants compounds include 1) bisabolone-9-one, 2) 4-methylene-5-hydroxybisabol-2,10-diene-9-one, 3) turmeronol B, 4) 5-hydroxy-1,7-bis(4-hydroxy-3-methoxyphenyl)-1-hepten-3-one, 5) 3-hydroxy-1,7-bis (4-hydroxyphenyl)-6-hepten-1,5-dione, 6) cyclobisdemethoxycurcumin, 7) bisdemethoxycurcumin, 8) demethoxycurcumin and 9) curcumin [4]. Again, some varieties contain significant amount of carbohydrates, proteins, fatty acid, essential oils, steroids and phytosterols [6]. These compounds possess pharmacological effects and therefore, consumption of turmeric in a very small amount has been proved to be helpful in order to manage several diseases like inflammatory bowel syndromes, cardiovascular diseases (CVD), neurological diseases, cancer, autoimmune disorders and several metabolic syndromes. These inflammatory bowel diseases include Crohn’s diseases and ulcerative colitis. Acute coronary syndrome, acute myocardial in fraction and dyslipidemia are the examples of CVD, against which turmeric plays vital role. Among the neurological disorders, turmeric consumption showed notable effect to lower the symptoms related to Alzheimer’s diseases, Parkinson’s disease, Huntington’s Korea and depression [7]. Some bioactive compounds which are present in turmeric including 1,8-cineole, ar-curcumene, ar-turmerone, pounds, including 1,8-cineole, ar-curcumene, ar-turmerone, β-elemene, camphor, curcumol, curdione, germacrone, linalool, xanthorrhizol, and zingiberene has cytotoxic effects against cancerous cell, Again, diabetes and associated secondary metabolic diseases are known to be managed by several components of turmeric; these include 1,8-cineole, ar-turmerone, curcumin, curcumol, demethoxycurcumin, germacrone, xanthorrhizol [6]. Some compounds of are effective against Diabetes and obesity and, Rheumatoid arthritis, osteoarthritis and lupus erythematosus [7].

Another most important spice in Bangladesh which is regularly used for the preparation of daily foods is chili (*Capsicum annuum L*). Chili is widely accepted in the cuisine in its fresh and dried form. The fresh green chili is a very good sources of flavonoids, minerals and several nitrogenous components [8]. It is also rich in ascorbic acid, thiamine, riboflavin, niacin and β-
carotene. Capsaicinoids including apsaicin, dihydrocapsaicin, nordihydrocapsaicin, homocapsaicin and homodihydrocapsaicin are the group of phenolic alkaloids which are the major compounds exerting antioxidant and antimicrobial properties [9]. In addition, the components of chili are attributed to work against pain, arthritis and rhinitis. Again, chili acts as immunity booster to control CVD, type-2 diabetes, obesity and also prevent prostate cancer [10].

Drying which is one of the necessary processing steps to preserve and store chili results in reduction in some of the nutritional contents like phenolics and ascorbic acids in a negligible amount [11,8,12]. It has been shown that the process of drying, drying temperature and duration of drying can possess varied effect on its physicochemical properties and sensory characteristics of chili. Kenno et al., (2020) has reported that half time for oven drying of chili at 70ºC is much less than that of sun drying at ambient temperature of 40ºC. In addition, the pH, ascorbic acid and color has been changed according to the variation of drying [12].

Likewise, after harvesting the rhizomes of turmeric, those are cured before drying. Curing involves the boiling of the rhizomes which causes the unvaried diffusion of the coloring materials throughout the rhizomes [13]. Later after drying rhizome is grinded into powder form to finally utilize for cuisine preparation. In general, the freshly harvested rhizome of turmeric is not used as spices, but the dried powder. Finally, the spices are commercially packed to send it in hands of the consumers. However, during these processing steps, including the drying and packaging, there is chance of changing the nutritional and medicinal contents.

From the beginning of industrialization at the end of 19th century the habit of people of this area changed considerably [14]. People moved from agricultural living area toward urban areas, where fresh foods are not available so easily.

Therefore, from that time the use and demand of packed spices increased dramatically with the changed life-style and urbanization in spite of variation of the nutritional contents. There are numerous data which aimed to measure the medicinal and nutritional compounds of the raw spices; however, those from the commercially packed and cooked spices are relatively absent. The present study aims to explore quantitative comparison of the moisture content, crude protein, crude fiber, mineral, phenolic compounds and antioxidant properties in two of the well-known spices- turmeric and red chilies.

Based on the aims of the research, we set some objectives of our studies which include:

1. Proximate analysis of the spices to determine moisture, ash, crude fiber and crude protein.
2. Determination of the total phenolic of raw and commercially packed turmeric and red chilies samples
3. Evaluation of the free radical scavenging activity of the stated samples
4. Comparative analysis between the raw and commercially packed spices.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted in the department of Biochemistry and Chemistry, Sylhet Agricultural University, Faculty of Biotechnology and Genetic Engineering, Sylhet-3100, Bangladesh. The duration of the study was 18 months.

2.2 Preparation of the Sample

The packed spices were purchased from local market. The raw spices were harvested, dried in sunlight and locally ground by conventional method. The raw and packed sample of turmeric and red chilies were soaked separately in ethanol, methanol and acetone depending on different tests required. For the preparation cooked sample, both the raw and packed spices were taken in hot water and tested for the total phenolic content.

2.3 Proximate Analysis

For the proximate analysis, directly dried samples were used.

2.3.1 Determination of dry matter

To determine the dry matter, approximately 1g of each sample were weighed and dried in oven at 72°C for 72 hours. The samples were then kept in desiccator and allowed to cool. Exposure of the dried samples was strictly avoided in order to prevent any variation in the result. After that the difference between the dried and wet samples were taken. Calculation:
Dry matter (%) = \frac{(B-A) - (C-A)}{(B-A)} \times 100

Here,
A = Weight of crucible (g)
B = Weight of crucible + weight of wet sample (g)
C = Weight of crucible + weight of dry sample (g)

2.3.2 Ash content determination

The dried samples prepared during the determination of DM were used to estimate the ash content. This dry ashing procedure used a high temperature muffle furnace and the samples were kept in a temperature of 450°C. After that all of the samples were kept in desiccator to until those were cooled and finally weighed to record the mineral content.

Calculation:
Ash (%) = \frac{A}{B} \times 100

Where,
A = Weight of ash + Weight of crucible (g)
B = Weight of dried sample + Weight of crucible (g)

2.3.3 Crude fiber estimation

This method gives the crude fiber content of the sample after it has been digested in H₂SO₄ and NaOH solutions and the residue calcined. To estimate CF, 1.25 g of each of the samples was taken in flasks where 100 ml 1.25% H₂SO₄ was added. The sample was then heated at 60°C for 35 minutes. During boiling, the flasks were swirled periodically to remove particles adhering to the sides. All the samples were then filtrated. The filtrate was then transferred to 100 ml 1.25% NaOH and again heated at 60°C for 35 minutes. After that samples were transferred in crucibles, dried and weights were recorded. Finally, all the crucibles were placed in furnace at 450°C for 4 hours, cooled and final weights were taken.

Calculation:
Crude fiber content (%) = \frac{A-B}{C} \times 100

Where,
A = Weight of crucible+ Weight of dried residue (g)
B = Weight of crucible+ Weight of ash (g)
C = Weight of sample (g)

2.3.4 Crude protein (CP) determination

Analysis of CP were done by Kjeldahl's method, which evaluates the total nitrogen content of the sample after it has been digested by sulfuric acid with a selenium catalyst. The entire procedure involves digestion, distillation and titrations steps.

The digestion step required 1g of each sample, which was taken in Kjeldahl flask. Addition of 25 ml of concentrated H₂SO₄ was followed by adding the selenium and heating each sample by placing them on a digestion set for 1 hour. Change in color was the end point of digestion step.

Distillation step was done by addition of 150 ml of distilled water. After that small glass beads and zinc granules were added. This step was followed by the addition of 100 ml 40% NaOH. All those samples containing flask was then placed in the distillation set immediately and started heating. Completion of distillation step follows the addition of 2% boric acid solution to trap the evolved NH₃.

Finally, standardized HCl was used to titrate the resulting distillate.

Calculation:

Nitrogen Content = \frac{Titrative value \times 0.014 \times Normality of HCl}{Weight of Sample} \times 100$

Crude Protein (%) = Nitrogen Content (%) \times 6.25

2.4 Estimation of Total Phenolic Content

The total phenolic content (TPC) of the crude extracts of the stated spices was determined colorimetrically using the method of Singleton et.al. (1999) and Khan & Choudhury et.al. (2010) [15,16]. All the determinations for each of the samples were replicated three times. The Folin-Ciocalteu method of total phenolics determination required tannic acid as standard (Concentration range: 0.25 to 1.50 mg/ml).

The reaction mixture was prepared by suspending 0.125g samples in 6.25ml of 75% aqueous acetone in test tubes. Two hours after suspension, the extracts were vortex mixed. This step was followed by addition of aliquots (0.1ml) of each extract with 0.5 ml Folin-Ciocalteu reagent. After 8 minutes interval, addition of 1.5ml of 20% Na₂CO₃ in each of the test tube
was done. Distilled water was added to produce the entire volume 10.0ml. Each of the test tubes was then incubated for 2 hours at room temperature. The absorbance was taken at a wavelength of 670 nm in the visible range of the spectrum using a colorimeter. Total phenolic content was expressed as mg tannic acid equivalent per g of sample DM.

2.5 Estimation of Tannin Content

Tannin contents of the samples were estimated by the method described by Khan (2012) [17]. The method is based on the differences between phenolics before and after tannin removal from the extract using poly vinyl pyrrolidone (PVP). 1ml of each sample that was prepared during phenolics determination was taken in test tubes and 0.1g of PVP was added. The samples were then vortex mixed, incubated at 4°C for 30 min which was followed by centrifugation for 5 minutes and collection of supernatants. After that 0.1 ml of supernatant was collected. 0.4ml of water, 0.25 ml of Folin-Ciocalteu reagent and 1.25ml 20% of NaHCO₃ were added to the supernatant. Tannic acid was used as standard in this method. The results were expressed as µg/g.

2.6 Antioxidant Activity Test: DPPH Radical Scavenging Activity

DPPH (1,1-diphenyl-2-picryl-hydrazyl), a dark color crystalline powder is a well-known free radical and scavenges other free radicals. Therefore, rate reduction of a chemical reaction upon addition of DPPH is used as an indicator of the radical nature of that reaction. Because of a strong absorption band centered at about 520 nm, the DPPH radical has a deep violet color in solution, and it becomes colorless or pale yellow when neutralized. This property allows visual monitoring of the reaction, and the number of initial radicals can be counted from the change in the optical absorption at 520 nm or in the EPR signal of the DPPH [18].

2.6.1 Qualitative analysis

In the qualitative assay, the methanolic extracts of the different spice samples were applied on thin layer chromatography (TLC) plate. 1,1-diphenyl-2-picryl-hydrazyle (DPPH) solution was then sprayed on the whole plate and kept at room temperature for 30 minutes. The presence of antioxidant substances was indicated by white spots against a pinkish violet background [19].

2.6.2 Quantitative analysis

The free radical scavenging activity of the extracts will be evaluated by 1, 1-diphenyl-2-picryl-hydrazyl (DPPH) according to the method described by Shen et.al. (2010) [20].

1ml of different concentrations of extracts and standards were taken in different test tubes. This was followed by addition of 1.2 ml 0.003% DPPH in methanolic solution to each tube. After 30 minutes of incubation the absorbance was measured at 517 nm.

% of inhibition of DPPH radical was calculated from the equation below:

\[
\text{% of inhibition} = \left( \frac{A_{DPPH} - A_S}{A_{DPPH}} \right) \times 100
\]

Where,

- \( A_{DPPH} \) = Absorbance of DPPH in absence of extract
- \( A_S \) = Absorbance of DPPH in present of extract or standard.

DPPH scavenging activity was expressed graphically by plotting the absorbance data (% of inhibition of DPPH radical) against the concentration using the slope of the nonlinear regression.

2.7 Statistical Analysis

Statistical analysis was done by CRD (completely randomized design) using Minitab 17 Software and Microsoft excels 2007.

3. RESULTS

3.1 Proximate Analysis

In the proximate analysis of turmeric (Table 1), both Radhuni and Tiger brand revealed the significantly highest content (p<0.001) of DM which were 97.28 and 97.56 mg/g, accordingly. Pran contained 93.42 mg/g DM. The lowest value was found in the raw turmeric (90.83 mg/g).

The CP among the commercially packed and raw turmeric did not show any significant differences. The highest value was found in raw turmeric which was 6.21 mg/g and the lowest value was 5.51 mg/g from Radhuni brand. Whereas, 6.06 mg/g and 6.18 mg/g crude protein were present in Tiger and Pran brand, respectively.

Crude Fiber concentration/content comparison among the packed and raw spices showed significant differences (p<0.001); Tiger turmeric
contained significantly higher content of CF (4.96 mg/g) and the lowest was found in Pran brand with a value of 1.76 mg/g. The CF content placed in between the highest and lowest value was recorded in Radhuni brand (2.36 mg/g) and raw turmeric (3.03 mg/g).

Significant result with the P value of less than 0.05 was indicative in the mineral content of turmeric. Analysis revealed the significantly highest content in raw turmeric (9.97 mg/g) and the lowest content in Tiger brand (8.23 mg/g). Radhuni and Pran brand had 9.05 mg/g and 8.84 mg/g mineral contents, accordingly.

Proximate analysis was also done for packed and raw chili which is shown in Table 2. We found significant amount of DM, CP, CF and ash contents in both packed and raw chili.

The DM in chili disclosed significantly highest content in Tiger brand with a value of 98.90 mg/g. Radhuni, Pran and raw turmeric had 88.80 mg/g, 90.78 mg/g and 89.78 mg/g DM, respectively.

Tiger brand of chili contained the highest amount of CP (6.02 mg/g; P< 0.02), while the lowest amount was observed in Radhuni brand (4.81 mg/g). Pran and raw chili had 4.96 mg/g and 4.88 mg/g CP, respectively. The fiber contents obtained for Tiger brand and Radhuni brand were (9.31 mg/g) and (2.48 mg/g), respectively, which represented the significantly highest and lowest amount. Analysis with ash content revealed significant differences (p<0.01) for all the samples. Raw chili showed the highest amount of mineral, while the lowest amount was found in Tiger brand.

### 3.2 Total Phenolics and Tannin Content

Total phenolics of acetone extracts of both packed and raw turmeric (Table 3) showed significant content (p <0.001); comparative analysis exhibited that raw turmeric had 39.823 µg/g tannin which was the lowest, however, Tiger turmeric had the highest value (93.306 µg/g). Pran and Radhuni had 62.645 µg/g and 69.689 µg/g tannin, respectively.

Acetone extracts of red chili showed variation among the phenol contents (Table 3). Phenol content was found significantly high in Tiger brand (29.91 µg/g). The phenol contents in Pran, Radhuni and the raw chili were 19.97 µg/g, 28.67 µg/g and 21.212 µg/g, respectively.

| Samples | Tiger | Radhuni | Pran | Raw | P value |
|---------|-------|---------|------|-----|---------|
| DM (%)  | 9.97a | 9.56a   | 9.42b| 9.83b| <0.001  |
| CP (%)  | 6.06a | 5.51a   | 6.18a| 6.21a| >0.1    |
| CF (%)  | 4.96a | 2.36bc  | 1.76c| 3.03b| <0.001  |
| Ash (%) | 8.23a | 9.05a   | 8.84a| 9.97a| <0.05   |

Statistical analysis was done by one-way ANOVA

| Samples | Tiger | Radhuni | Pran | Raw | P value |
|---------|-------|---------|------|-----|---------|
| DM (%)  | 98.90a| 88.80b  | 90.78b| 89.78b| <0.001  |
| CP (%)  | 6.02a | 4.81b   | 4.96b| 4.88b| <0.02   |
| CF (%)  | 9.31a | 2.48c   | 5.50b| 4.78b| <0.001  |
| Ash (%) | 8.32b | 9.39a b | 9.02a b| 13.24a| <0.01   |

Statistical analysis was done by one-way ANOVA

| Samples | Concentration of Turmeric | Concentration of Chili |
|---------|---------------------------|------------------------|
| Tiger   | 93.30±5.1243a             | 29.91±5.42a            |
| Radhuni | 69.68±1.243a              | 28.67±6.21a            |
| Pran    | 62.64±0.718 b             | 19.97±2.15b            |
| Raw     | 39.82±1.192c              | 21.21±2.143b           |
| P value | <0.001                    | <0.001                 |

Statistical analysis was done by Regression analysis
Table 4 exerted a comparison among the spices in terms of tannin. Analysis revealed significant (P<0.005) highest level of tannin in raw turmeric while the opposite in Radhuni brand turmeric. Variations were reflected from the results found in the tannin content of chili presented in Table 4. Tannin content was found significantly high in Tiger brand chili (16.57 µg/g) and low in raw chili (3.315µg/g). Pran and Radhuni brand chili had 6.63 µg/g and 10.36 µg/g of tannin, respectively.

### 3.3 DPPH Free Radical Scavenging Activity

Both the qualitative and quantitative assays of DPPH free radical scavenging activity was performed. Fig.1 shows the assessment of DPPH free radical scavenging activity of methanolic extracts of different samples. Here, vitamin C was used as the standard. At a concentration of 50µg/ml, all the extracts of spices and vitamin C exhibited almost similar range of inhibition which can be placed 10-20% of inhibition. The results represent that both the raw and commercially packed turmeric and red chili possess free radical scavenging activity.

In case of quantitative assay, at 200 µg/ml of DPPH, Radhuni and raw chili showed the same % of inhibition, which was the highest. While the lowest value at this concentration was found in tiger turmeric.

At 500 µg/ml of DPPH level, all the packed chili exhibited the highest result with a same value. However, the lowest rate of inhibition was found with raw turmeric. The free radical scavenging activity of different extracts at this concentration of DPPH was in the following order: Radhuni chili> Tiger chili> Pran chili > Raw chili > Pran turmeric > Radhuni Turmeric, Tiger Turmeric > Raw turmeric (Fig. 2).

### 4. DISCUSSION

Proximate compositions, antioxidants, total phenolics and tannins were measured in two commonly used food condiments in Bangladesh. The commercially packed turmeric and red chili from three different brands and the raw spices were investigated. Determination of dry matter reflects the moisture content. To ensure the quality of any food and to preserve it for long time without any deterioration, it is important to maintain the accurate moisture content [20]. Presence of over 8% moisture content is responsible for the development of an insect friendly environment. Again, moisture content over 14% results in the growth of various types of bacteria and fungi [21].

Table 4. Comparison between Spices in terms of tannin content (µg/g)

| Samples | Concentration of Turmeric | Concentration of Chili |
|---------|---------------------------|------------------------|
| Tiger   | 19.89±1.44 b              | 16.57±1.10 a           |
| Radhuni | 9.53±2.19 c               | 10.36±2.90 a           |
| Pran    | 16.33±2.99b               | 6.63±2.31 b            |
| Raw     | 33.89±1.77a               | 3.315±0.829c           |
| P value | <0.005                    | <0.001                 |

Statistical analysis was done by Regression analysis

![Fig. 1. TLC method for qualitative analysis of DPPH free radical scavenging activity; RC-Radhuni chili, TC-Tiger chili, RwC-Raw chili, RT-Radhuni turmeric, TT-Tiger turmeric, RwT-Raw turmeric](image-url)
In the present study, comparison revealed that Tiger brand had the highest content of dry matter, which indicated that nutrients and water were in a good balancing proportion. However, decreased content of dry matter is indicator of increased moisture content. In our study, raw turmeric and Radhuni chili had the significantly higher content of moisture. This may happen due to the simple diffusion of water from the atmosphere.

Protein is an important nutritional constituent. Estimation of crude protein can reflect the presence of approximate amount of protein content. Presence of high amount of CP is an index of increase amount of protein supplement. Among all the spices, only the tiger brand contained significant amount of protein that demonstrate the high-quality nutrient value.

Determination of crude fiber is used in evaluation the efficiency of milling and separating bran from the starchy endosperm. Higher fiber content in food decreases the risk of chronic diseases such as cardiovascular diseases, diabetes, obesity etc [22]. Its ability to bind water helps to eliminate waste products from gastrointestinal tract. In addition, lignin fraction binds to low density lipoprotein and therefore, acts as a detoxifying agent [22]. As the Tiger turmeric and red chili contained significant amount of crude fiber, it certainly provides many health benefits than any other spices.

Ash content is essential to a food’s nutrition and longevity. Ash or total mineral content is the portion of the food or any organic material that remains after it is burned at very high temperatures. The ash constituents include potassium, sodium, calcium and magnesium, which are present in larger amounts as well as smaller quantities of aluminum, iron, copper, manganese or zinc, arsenic, iodine, fluorine and other elements present in traces. Usually, minerals represent less than 7% of the total component [23]; greater than this amount may represents impurity. In our study, we got remarkably higher amount of ash content, which may represent the introduction of impurity during spice processing that include drying and grinding.

As it is evident that presence of phenolic content in food constituent possesses a variety of health benefits [24], therefore, the more the phenolic contents the more it helps to combat many diseases. Data recorded for from both the turmeric and red chili from Tiger brand showed the highest content of phenolics and so obviously will be beneficial for health.

Tannin in its lower content though has convincing positive effects on health; higher tannin content however is responsible for decreased feed efficiency, food intake, growth rate, net metabolizable energy and protein digestibility [25]. It should be stated that high level of tannins in diet (60-120 g/kg DM) may depress digestive efficiency and productivity [17]. Raw spices containing the significantly higher level of tannin content therefore reflects is comparative low quality.
According to a study [26] plants with lower phenolic contents exhibit lower antioxidant activity; this represents a positive correlation. In our study, both Radhuni and Tiger brand chili possess a significant amount of antioxidant properties; the obtained results indicate that free radical scavenging activity may be attributed to the high contents of phenolics with a higher reducing ability. Likewise, lower phenolic content in raw turmeric and raw chili recorded for both spices which directly support their lower antioxidant activity. However, for the assessment of antioxidant potential of endogenous compound, a single assay method is not sufficient.

5. CONCLUSION

The determination of proximate, antioxidants, phenolics and tannin of the raw and commercially packed turmeric and red chili revealed that all the nutritional contents were mostly preserved in the Tiger brand; this indicates that safety measures have been ensured processing and packaging of these spices. The moisture content, fiber and protein contents, the amount of antioxidants and other nutrients reflects that standards of preservation and the quality assurance. Therefore, Tiger brand has confirmed the legal amount of nutrients, microbial stability, spice processing operations and certainly the quality value of locally ground raw spices. Finally, the study provides insights about the standard guidelines, sensitivity, specificity and accuracy that are followed by some vendors of spices.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Spices Research Centre. Production technology of spice crops, Bklt-01/2005. Bangladesh Agricultural Research Institute, Shibgonj, Bogra; 2005.
2. Huda FA, Islam MS, Biswas H, Islam MS. Impact assessment study on selected spice crops under action plan in Bangladesh. Progress. Agric. 2008;19(2): 229-241.
3. Fisher C. Phenolic compounds in food and their effects on health I. Phenolic Compounds in Spices. 1992;9:118–129.
4. Akter J, Hossain MA, Takara K, Islam MZ, Hou DX. Antioxidant activity of different species and varieties of turmeric (Curcuma spp): Isolation of active compounds. Comparative Biochemistry and Physiology Part - C: Toxicology and Pharmacology. 2019;215:9–17.
5. Tanvir EM, Hossen MS, Hossain MF, Afroz R, Gan SH, Khalil MI, Karim N. Antioxidant properties of popular turmeric (Curcuma longa) varieties from Bangladesh. Journal of Food Quality. 2017;1-9.
6. Umar NM, Ivan TP, Aminu N, Toh SM. Phytochemical and pharmacological properties of curcuma aromatica salisb (wild turmeric). Journal of Applied Pharmaceutical Science. 2020;10(10):180-194.
7. Hay E, Lucariello A, Contieri M, Esposito T, De Luca A, Guerra G, Perna A. Therapeutic effects of turmeric in several diseases: An overview. Chemico-Biological Interactions. 2019;310:108729.
8. Kama MM, Ali MR, Rahman MM, Shishir MRI, Yasmin S, Sarker MSH. Effects of processing techniques on drying characteristics, physicochemical properties and functional compounds of green and red chilli (Capsicum annuum L.) powder. Journal of Food Science and Technology. 2019;56(7):3185–3194.
9. Mohammed Alsebaeai. Innovations in food technology. In innovations in food technology, consumption of green chilli and its nutritious effect on human health. E-book; Springer Nature Singapore; 2020.
10. GMM P. Current advances in pharmacological activity and toxic effects of various capiscum species. International Journal of Pharmaceutical Sciences and Research. 2017;8(5):1900–1912.
11. Azizuddin, Kiran, Yasmeen K. Nutritional changes in shahzadi chilli during maturity from green to red stages. Analytical Chemistry Letters. 2019;9(5):664–671.
12. Kennao E, Kumari A, Singh M, Hossain SA, Das A, Wasnik PK. Journal of Food Processing and Technology Effect of Drying on Physicochemical Characteristics of Bhut Jolokia (Chilli. Journal of Food Processing and Technology). 2020;11(3): 283.
13. Food and agriculture organization of the united Nations (FAO). Tumeric post-harvest operations compendium. Post-Harvest Compendium. 2004;21.
14. Sharma MM, Sharma RK. Corainder, In: K. V. Peter. (Ed.), Handbook of Herbs and Spices. 2004;2:157.

15. Singleton VL, Orthofer R, Lamuela-Raventos RM. Analysis of total phenols and other oxidation substrates and antioxidants by means of Folin-Ciocalteu reagent. Methods Enzymol. 1999;299: 152-178.

16. Khan MMH, Chaudhry AS. Chemical composition of selected forages and spices and the effect of these spices on In vitro rumen degradability of some forages. Asian Australasian Journal of Animal Science2. 2010;3:889-900.

17. Khan MMH. Novel supplement to improve utilization of low-quality forages in ruminants. Chapt 1: Introduction. 2012;12-14.

18. Wikipedia. DPPH; 2016. Available:https://en.wikipedia.org/wiki/DPPH

19. Sarker SD, Z Latif, Gray AI. Methods in Biotechnology: Natural Product isolation, 2nd ed. S D. Sarker, Z Latif, Gray A I. Chapt:1 Natural Product Isolation. 2006;1-27. Shen Q, Zhang B, Xu R, Wang Y, Ding X, Li P. Antioxidant activity In vitro of selenium-contained protein from the se-enriched Bifidobacterium Animalis 01, Anaerobe. 2010;16:380-386.

20. Nielsen SS. Food analysis laboratory manual. 2nd ed. Food Science Text Series.

21. Cockerell Y, Francis B, Halliday D. Changes in nutritive value of concentrate feeding-stuffs during storage. In proceedings of the conference on the development of feed resources and improvement of animal feeding methods in the cento region countries London. Tropical Products Institute. 1971; 181-192.

22. Erkkilä AT, Lichtenstein AH. Fiber and cardiovascular disease risk: how strong is the evidence? J Cardiovasc Nurs. 2006;21(1):3-8.

23. Food Science;2012. Available:http://www.foodscience-avenue.com/2012/11/ash-content-in-food.html

24. Hollman PCH. Evidences of health benefits of plant phenols: local or systemic effects? J of the Science of Food and Agriculture. 2001;81(9):842-852.

25. Chung K-T, Tit Yee Wong, Cheng-I Wei, Yao-Wen Huang, Yuan Lin. Tannins and human health: A review. Critical Reviews in Food Science and Nutrition. 1998;38(6): 421–464.

26. Piluzza G, Bulitta S. Correlation between phenolic content and antioxidant properties in twenty-four plant species in traditional ethnoveterinary use in the mediterranean area. Pharma Biol. 2011;49(3):240-247.