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Proximate Composition of Selected Spices Marketed in Kano State, Nigeria

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Abstract: *Spices play a vital role in enhancing the flavour, aroma, and nutritional value of culinary preparations. Understanding the proximate composition of spices is essential to evaluate their potential contributions to a balanced diet and overall human health. This study assesses the proximate composition of nine selected spices (viz: Fenugreek, Cardamom, White pepper, Anise, Rosemary, Coriander, Cumin, Fennel, and Allspice). The findings demonstrated that these spices exhibit varying concentrations of carbohydrates, crude protein, fiber, fat, moisture, and ash. Proximate analysis revealed significant differences ($p < 0.05$) between the mean values of the spices, with moisture ranging from 7.33% to 17.00%, ash-2.36% to 28.56%, fat-1.10% to 25.13%, fiber-14.67% to 44.67%, protein-7.47% to 46.50%, and carbohydrate-2.06% to 46.28%. The results revealed that the proximate contents of the sampled spices were higher than the recommended dietary allowance (RDA) standard by the Food and Agricultural Organization (FAO) of the United Nations. The carbohydrate content of the spices was within the RDA and also fibre content was slightly higher than the RDA. These findings highlight the rich nutritional profile of the sampled spices, offering potential as valuable dietary additives. Further research and consideration of appropriate consumption quantities are necessary to fully harness the benefits of these spices in promoting human health and well-being.*

Keywords: *Proximate, Spices, Kano and Nigeria.*

Introduction

Spices have been used for centuries as a natural flavouring agent and as a medicine in different parts of the world. They are obtained from various parts of plants such as roots, leaves, stems, seeds, fruits, and bark, and have been shown to possess numerous health benefits due to their chemical constituents (Ntana and Tsaftaris, 2021). Spices are distinguished from herbs, which are the leaves, flowers, or stems from plants used for flavouring or as garnish (Dubey, 2017; Sachan *et al*., 2018). Spices have also been used for their medicinal properties, as they are rich in bioactive chemicals that possess therapeutic properties. The use of spices is not only limited to food and medicinal purposes but also in the cosmetic and perfumery industries. Spices are also used in the production of essential oils, oleoresins, and natural food colorants. The bulk of the dry material of spices contains carbohydrate and organic compounds having diverse functional groups.

In recent years, there has been growing interest in the health benefits of spices due to their high content of bioactive chemicals such as phenolics, flavonoids, terpenes, and alkaloids (Ntana and Tsaftaris, 2021). Spices have been reported to possess antimicrobial, anti-inflammatory, anticancer, antidiabetic, and antihypertensive properties, which are actively used in preclinical, clinical, and therapeutic trials investigating new treatments of diseases (Ranasinghe *et al*., 2012; Jiang, 2019). Spices are also used in traditional medicines for their health-enhancing properties as they are cheap and easily available (Sachan *et al*., 2018). Their traditional uses include treating various digestive problems, dental problems, and infections, as well as preventing and treating chronic diseases such as diabetes, cancer, stomachache, leprosy, cough, loss of appetite, rheumatoid pain, convulsion, inflammation, and cardiovascular disease (Adeola *et al*., 2020). The medicinal properties of these spices have been confirmed by modern scientific research (Aggarwal *et al*., 2013; Butt *et al*., 2013; Suresh and Mathew, 2015).

The nutritional value of food that we eat greatly governs our health and therefore, most of the activities that we do in our life. Our food is the only source of energy and vitamins for our body and is responsible for the efficient metabolism of the same. It is true that spices are not the major sources of macronutrients (carbohydrates, proteins and lipids) but they can be potential sources of micronutrients. Studies have shown that the nutritional composition of spices can vary depending on the plant species, growing conditions, and processing methods (Ogbuewu *et al*., 2014; Adepoju and Ojo, 2019).

This study is aimed at evaluating the proximate composition of selected spices marketed in Kano State, Nigeria for food flavoring and promotion of good health.

Materials and Methods Sampling

Nine (9) most commonly used spices in Kano, Nigeria were selected for analysis. The spices include; All-spice, Cardamom, Coriander, White pepper, Cumin, Rosemary, Fenugreek, Fennel, and Anise, during the month of January, 2023. The samples were obtained from Tarauni Market**.**

Sample Preparation

The spices samples were cleaned using water to remove the soil and other materials on them. The spices samples were then oven-dried at 80ºC for 6 hours. The dried samples were then crushed using mortar and pestle which were then sieved and the process was repeated and was passed through 2mm sieve. The powder was stored in dry air-tight containers and kept in the laboratory at room temperature (25ºC) prior to further analysis.

Sample Analysis

Estimation of ash

Two gram each of the samples was weighed in a silica crucible and heated in muffle furnace for about 5-6 h at 500°C. The crucible was cooled in a desiccator and weighed. It was heated again in the furnace for half an hour, cooled and weighed. The process was repeated till the weight became constant. The final weight gave the ash content of the samples.

$$\text{Ash content (\%)} = \frac{\text{weight of crucible with ash} - \text{weigh of crucible}}{\text{weight of sample}} \times 100$$

Estimation of moisture

A crucible was oven dried at 105ºC for 20mins and transferred to a desiccator to cool. The weight of the empty crucible was taken on a weighing balance. 3g of sample was then weighed in the crucible and dried in an oven which was set at 135ºC for 2hrs. After drying, the crucible was placed in a desiccator to cool before finally weighing the dried sample.

$$\text{Moisture content (\%)} = \frac{W1-W2}{W1-W} \times 100$$

Estimation of Crude Fat

Two gram (2.0g) of each sample was packed into a weight extraction thimble and introduced into a soxhlet apparatus connected to a solvent flask, containing required quantity of solvent (petroleum ether) and was connected to a condenser, the flask was then placed in a heating mantle at 70ºC and the extraction was carried out for 8hrs. On completion, the thimble was removed and the petroleum ether was evaporated in a water bath. The extract was then placed in an oven for 30mins at 110ºC. It was cooled in a desiccator and weighed.

$$\text{Crude fat (\%)} = \frac{\text{weight of flask with fat} - \text{weight of flask}}{\text{weight of sample}} \times 100$$

Estimation of Crude fibre

Two gram (2.0g) of each sample was treated with 200ml of 0.128M H_2SO_4 and the mixture was boiled for 30 min. After filtration and washing with hot water, the residue was treated and boiled with 200ml of 0.313M NaOH solution for 30mins. After another filtration and washing with hot water. The residue was placed in a crucible and water was evaporated using hot plate. The fibre was then dried in a hot air oven for 2hrs at 130ºC and finally weighed after cooling. It was then ignited in a muffle furnace at 550ºC for 2hrs and the ash weighed after cooling in a dessicator. Loss in weight gave the weight of the crude fibre.

$$\text{Crude fibre (\%)} = \frac{\textbf{weight of crucible with fibre} - \textbf{weight of crucible with ash}}{\textbf{weight of sample}} \times 100$$

Estimation of crude protein

The crude protein was determined following micro Kjeldahl method. The total protein was calculated by multiplying the evaluated nitrogen by a constant value of 6.25.

$$\text{Total Nitrogen (\%)} = \frac{V1 \times n1 \times F1 \times MWn}{Ws \times 10} \times 100$$

Therefore; Crude Protein (%) = 6.25 × %N

Estimation of total carbohydrate

The percentage of carbohydrate was calculated using the formula: 100-(percentage sum of food nutrients).

Carbohydrate content (%) = 100 - (% moisture + % crude protein + % crude fibre + % ash + % crude fat).

Statistical Analysis

All data were subjected to statistical analysis. The values reported as mean ± standard deviation (SD) while One-way ANOVA was used to test for differences between the various spices using statistical package for social sciences (SPSS) version 22. Post-Hoc analysis was performed using Tukey HSD. The results were considered significant at *P*-values of less than 0.05 that is at 95% confidence level ($P < 0.05$).

RESULTS AND DISCUSSION

The results of Figures 1-6 showed the proximate composition of the selected spices. The fat content of the sampled spices are in the order: Cardamom (25.13±3.93%) > Anise (15.87±8.95%) > Fennel (7.27±4.74%) > Cumin (4.73±1.94%) > Fenugreek (4.37±1.06 %) > All spice (3.87±1.36%) > Coriander (2.30±0.82%) > White pepper (2.07±1.10%) > Rosemary (1.10±0.36%) as shown in Figure 1.

Figure 2 shows the ash content of the selected spices. From the results, Coriander had the highest ash content of 28.56±0.94% followed by Cardamom (26.51±0.45 %) and Fennel (22.4±0.73 %). Anise had the lowest ash content of 2.36±0.35%.

Figure 3 shows the fibre content of the selected spices. From the results, Anise had the highest fibre content of 44.67±11.85% followed by Rosemary (33.33±2.08) and Coriander (30.67±4.04%) and Cardamom (30.33±1.15%). White pepper had the lowest fibre content of 15.00±2.00%. Figure 4 showed that White pepper has the highest moisture content of 17.00±4.36% followed by Coriander (13.67±2.31%) and Fenugreek (11.5±0.5%). The lowest moisture content was observed in Cardamom (8.50±3.04%). The protein content is shown in Figure 5. The results reveal that Fenugreek had the highest protein content of 46.5±5.22% followed by Rosemary (38.98±1.35%) and White pepper (28.99±4.18%). Cardamom had the lowest protein content of 7.47±2.09%. The results revealed that carbohydrate contents of the sample spices was highest in All spice (46.28±4.18%) followed by Cumin (37.86±1.22%) and White pepper (32.17±7.83%). The lowest carbohydrate content was observed in Cardamom (2.06±1.72%) as shown in Figure 6.

Comparison between Recommended Dietary Allowance (RDA) for Proximate Compositions

The results indicated that total carbohydrate, crude protein, fiber, fat, moisture and ash contents of the sample spices are higher than Recommended Dietary Allowance value (RDA) (2006). The results further showed that fiber content of Fenugreek (14.67±1.53 g/100g) and White pepper (15.00±2.00 g/100g) were slightly lower that the RDA of 19-38 g/day. Similarly, the carbohydrate content of Allspice is lower than the RDA of 60-120 g/day.

The moisture content observed in this study was lower than the average 80.0±2.2% observed by Khan *et al*. (2013) in some edible plants. Similar study by Imran *et al*. (2007) found moisture content in the range of 81.31 and 90.54% in some selected spices. However, it was close to some common leafy vegetables such as *Xanthosem sagittifolum* (13.17%) and *Adensonia digitata* (9.5%) (Ladan *et al*., 1996). Moisture is considered as a good source of water and it is necessary that 20% of the total water consumption must come from food moisture (FNB, 2005). Temple *et al*. (1996) state that high moisture content in foods encourages microbial growth. The fat content of the sampled spices ranged between 1.10±0.36 - 25.13±3.93%. This is comparable to the fat content of 11%, 28.2% and 29% found in selected plants leaves (Imran *et al*., 2007). From this study, the fat content seems to be fairly constant and independent of origin as suggested by (Nasri *et al*., 2005). The high amount of fats in these spices is comparable to the content found in seeds used for production of commercial vegetable oils such as sunflower seed (22–36%) and rapeseed (22–49%) (Belitz *et al*., 2004).

The ash content of these samples showed that the spices were rich in minerals. The value obtained was higher compared to 1.8% reported in sweet potato leaves, and 5% in *Tribulus terristris* leaves, 1.85% in *A. viridus* leaves, 2.70% in *C. murale* leaves, 1.77 and 3.10%, in *N. officinale* and *S. pectenveneris* leaves respectively (Imran *et al*., 2007). It has been posited by Pomeranz and Clifton (1981) that ash contents of nuts, seed and plant leaves should fall in the range 1.5-2.5% in order to be suitable for animal feeds. The protein content of the samples ranged between 7.47±2.09 - 46.5±5.22%. This value was higher compared to 2.11% in *A. viridus*, 2.98% in *C. murale* leaves, 2.76% in *N. officinale*, 6.30% in water spinach and 6.40% in *Momordica foecide* leaves (Imran *et al*., 2007). The present finding was comparable to that of Akindahunsi and Salawu (2005) who observed protein content of 11.29% in balsam apple leaves, 24.85% in sweet potato leaves, *Piper guineeses* and *Talinum triangulare* with values of 29.78 and 31.00%, respectively.

The high level of fiber in diet can cause intestinal irritation, lower digestibility, difficult absorption of minerals found in plant and overall decrease nutrient utilization (Imran *et al*., 2007). The carbohydrate content of sampled spices ranged between 2.06±1.72 - 46.28±4.18%. These values were significantly close compared to the carbohydrate contents of 55.67% to 82.8% in some plant materials (Khan *et al*. 2013). These values are comparable to the carbohydrate levels of 3.38 and 7.32% observed by Imran *et al*. (2007). Carbohydrates are principal and indispensable source of energy.

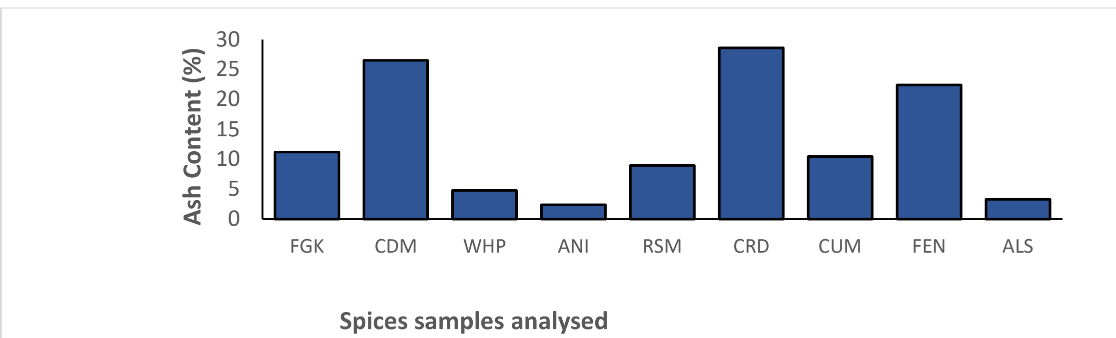

Figure 1: Ash content of the spice samples analyzed (%)

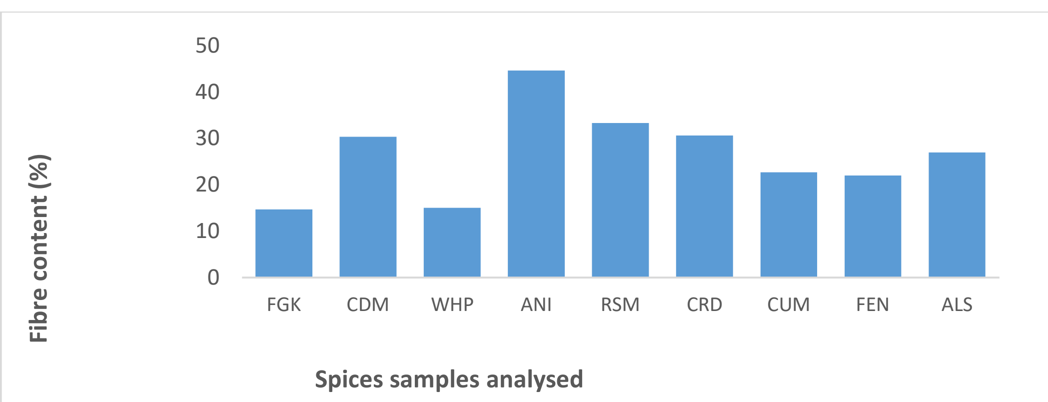

Figure 3: Fibre content of the spice samples analysed (%)

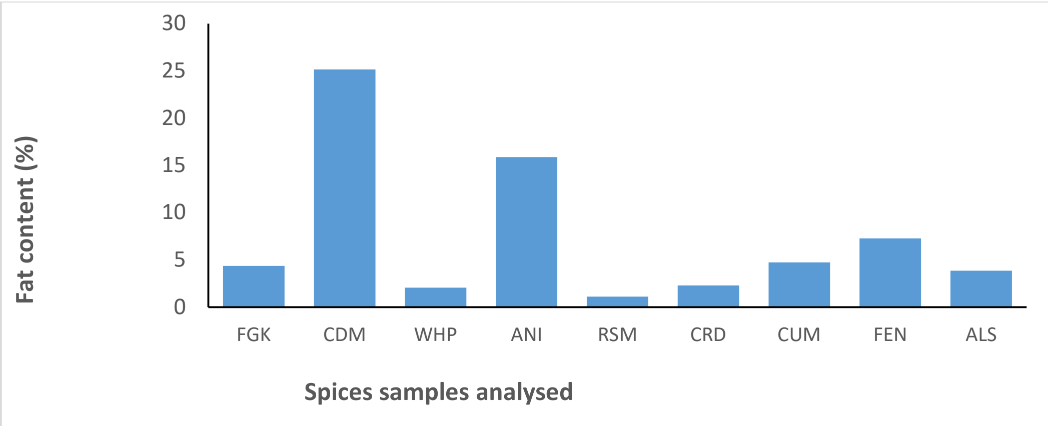

Figure 1: Fat content of the spice samples analyzed (%)

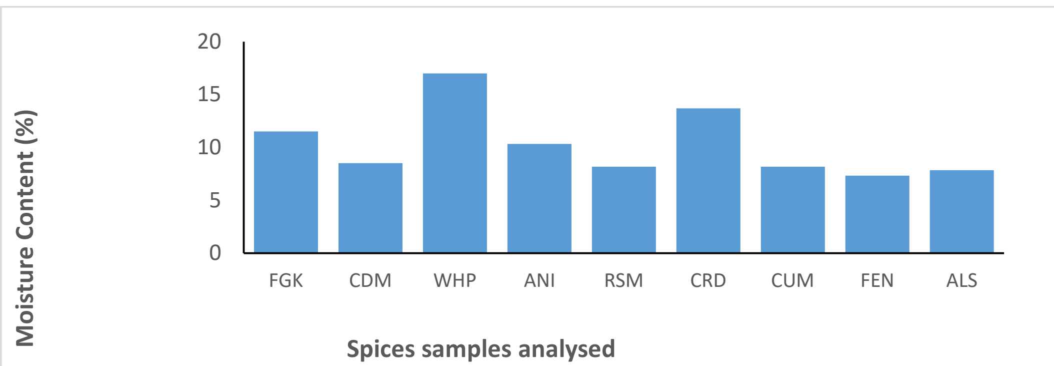

Figure 4: Moisture content of the spice samples analyzed (%)

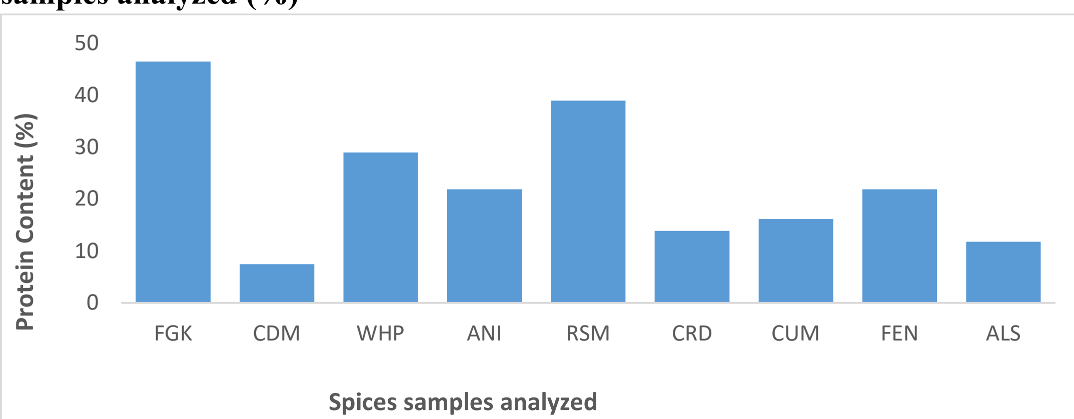

Figure 5: Protein content of the spice samples analyzed (%)

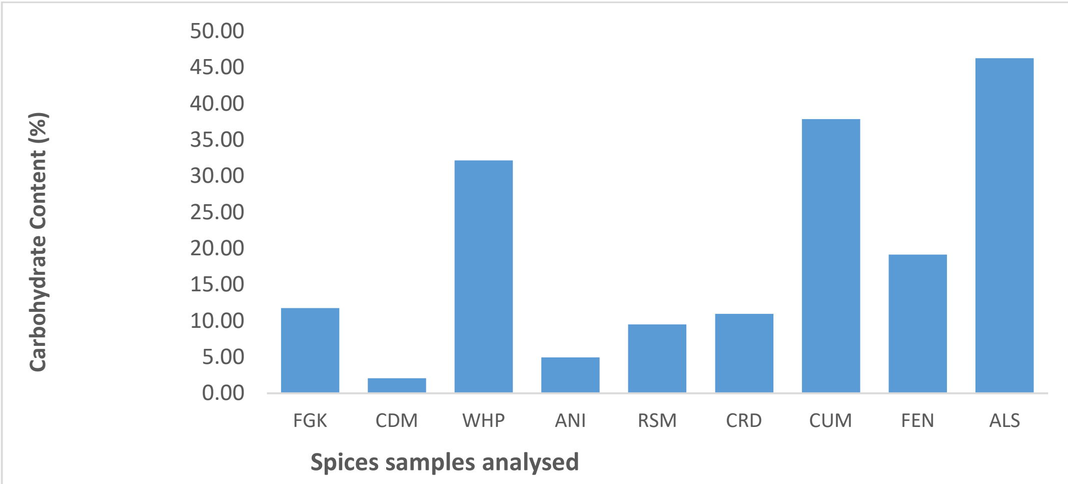

Figure 6: Carbohydrate content of the spice samples analyzed (%)

Conclusion

The result of this study showed that the spices – (Fenugreek, Cardamom, White pepper, Anise, Rosemary, Coriander, Cumin, Fennel and All spice) contain high amount of carbohydrate, crude protein, fiber, fat, moisture and ash in varying concentrations.

The results revealed that the proximate contents of the sampled spices were higher than the recommended dietary allowance (RDA) standard by Food and Agricultural Organization (FAO) of the United Nation. The carbohydrate content of the spices was within the RDA and also fibre content was slightly higher than the RDA.

Authors' Contributions
Dagari M.S.: Conceptualization and design of the research work
Khadija, K.: Undertaking the research work, write-up and data analysis.
Mohammed, M. I.: Supervision and Editing of the write-up

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