Nutritional Value and Elemental Analysis of *Cynomorium coccineum* L. Grown in Libya

Hanan S. Adem
Department of Biological Science
(The Libyan Academy)
Tripoli, Libya

E-mail: hananadem77@yahoo.com

Abdurazag A. Auzi

Faculty of Pharmacy
(University of Tripoli)
Tripoli, Libya
E-mai:abdurazagauzi@yahoo.com

***Abstract*-------The present study aims to determine the nutritional value of the powdered stems of *Cynomorium coccineum* L. grown in Libya, using standard analytical methods. The proximate analysis revealed the crude protein, crude fat, crude fibre, ash, moisture and carbohydrate content were 9.633 ± 0.205 %, 1.656 ± 0.004 %, 3.073 ± 0.12 %, 5.276 ± 0.016 %, 10.513 ± 0.026 % and 69.849 ± 0.074 %, respectively. The computed energy value was 332.834 ± 1.152 Kcal/g. The analysis of mineral elements showed that the plant stem contains high levels of calcium, sodium and potassium 19940 53 g/g, 2273 20 g/gand13840 g/g, respectively, and low levels of manganese, iron, copper, zinc and cobalt at 156 g/g, 124 g/g, 112 2.8 g/g, 54 g/g and 20 g/g respectively. The findings of the present study indicate that the plant's stem contains an appreciable amount of nutrients and mineral elements, and further supports its potential use in nutraceutical formulations.**

***Keywords*--------*Cynomorium coccineum*,** Proximate analysis, Mineral element analysis, Libya**.**

I. INTRODUCTION

Besides having pharmacologically important phytochemical. Medicinal plants have its own nutrient composition. Nutrients such as carbohydrates, fats, proteins, and dietary fibre, these nutrients are crucial for proper physiological and metabolic activities of the human body [1]. Therefore, evaluation of their nutritional significance can provide a better understanding of the worth of these species of plants [2]. Mineral elements are also of great physiological significance, though they usually form trace amounts of the total constituents of most plants [3]. These elements exist in different concentrations in various parts of the plants [4].

It has been established that many mineral elements are essential for ensuring the overall health and wellbeing of the human body [3]. Some minerals including potassium, calcium, sodium, magnesium, phosphorus, sulfur and chlorine, since the body needs more than 100 mg per day are known as “minerals” whereas, that are required in amounts lower than 100 mg per day are called “trace elements” such as copper, iodine, iron, manganese, selenium, zinc, molybdenum and chromium so on. Identifying of mineral elements in plants is significant, because the quality of various foods and medicines influenced by both the concentration and kind of minerals [5].

Cynomorium coccineum L., (tarthuth) belongs to the family Cynomoriaceae. Plant is fleshy, with holoparasitic roots and no leaves, no chlorophyll. They parasites host plants' roots, via the haustorium [6]. The plant emerges from the sand following the rains in winter for only a brief period each year. It is found in the southern parts of Italy, Spain, and also in Sicily, Malta and Crete [7],[28]. It is found in Libya, in Tobruk, Nalut, Ghade, Wadi Al-athal, Ghadames and Zwara[8]. Traditionally, it is used to treat dysentery and haemorrhoids, for nasal and uterine

bleeding, as a tonic, laxative and astringent, it was also used as food with their therapeutic benefits [7]. Few studies have focused on the nutritional value of *C. coccineum.* Therefore, the aim of this study was to assess the nutritional value of *C. coccineum* grown in Libya.

II. MATERAILS AND METHODST

A. Plant collection and identification

Aerial parts of *C. coccineum* L. were collected from Zwara (200 Km west of Tripoli, Libya) in March 2016. The plant was identified and classified by Dr. Mohammed Abu-Hadra, a plant taxonomist, at Department of Botany, Faculty of Sciences, University of Tripoli. The voucher sample (D681711) was kept in the herbarium, Department of Botany, University of Tripoli. The plant was cut into small slices and dried under shade at room temperature, and then ground into a powder state using the grinder.

B. Proximate analysis

A powdered sample of *C. coccineum* was subjected to proximate analysis to determinate of the major nutritional components as described by [9].

1) Determination of crude protein

Determination of crude protein content was utilizing the micro-kjeldahl (Foss Analytical, Hoganas, Sweden) method, includes three main steps: digestion, distillation and titration, 0.700 g of the sample were placed in a Kjeldahl digestion tube, and 12 ml concentrated sulphuric acid, 4.8 g of sodium sulphate, 0.07 g of copper sulphate and 0.05g of selenium were added. Then, the digestion tube was placed on the rack in the digester unit. The sample was digested at 420 ºC for nearly 1 hour, up to the sample had a clear pale green appearance, 23ml of 4% boric acid solution were transferred to a receiving flask, and 5 drops of methyl red indicator were added. The flask was placed under the Kjeldahl condenser. Then 80 ml of distilled water and 50 ml of 40% sodium hydroxide solution were added. Finally, distillation was started, 0.1 N hydrochloric acid was added to a burette, and the contents of the flask were titrated. A blank was also titrated under the same conditions. The percentage of protein was calculated based on the following formula (1):

Crude protein (%) = nitrogen (%) x 6.25

2) Determination of crude fat

To determinate the crude fat, 5 g of the sample were placed in an extraction thimble and closed with absorbent cotton. Then, 50 ml of petroleum ether (40 60 ºC) were added to a pre-weighed extraction cup. Both the thimble and cup were connected to the extraction unit of a Soxtherm apparatus (Gerhardt, Konigswinter, Germany). The sample was extracted using the solvent for 30 minutes after which rinsing for 1.5 hours. The solvent was vaporized from the cup and condensed in the condensing column. The extracted sample was allowed in an drying oven at 110 ºC for 1 hour, and once cooled, the crude fat percentage was calculated based on the following formula (2):

Crude fat (%) = (Extracted/Sample weight) x 100

3) Determination of crude fibre

To determine the crude fibre, 5 g (W) of the sample were allowed in a glass crucible and connected to the crude fibre extractor (VELP Scientifica, Usmate Velat. Italy). Then, 150ml of a boiling 1.25% sulphuric acid solution was added to the sample which was then digested for 30 minutes. After this, the acid was removed and the sample was rinsed thoroughly with boiling distilled water. Thereafter, 150 ml of 1.25 % sodium hydroxide solution were added and the sample was allowed to digest for 30 minutes, and then, the alkali was removed, the sample was rinsed with boiling distilled water. In the final step, after the crucible was removed from the extraction unit, it was dried in an oven at 110º C overnight. The sample was left to cool in a desiccator and weighed (W1) then ashed at 550 ºC in a muffle furnace for 2 hours, cooled in a desiccator and reweighed (W2). The quantity of extracted fibre was determined as a percentage of the original undefeated sample and calculated based on following formula:

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

4) Determination of moisture content

Approximately 5 g (W) of dried *C. coccineum* powder were placed in a well-dried dish previously weighed (W1), and the dish was put in the oven at 130 ºC for 1.5 hrs. Then, the dish was placed in a desiccator until cooling and reweight it (W2). The moisture content percentage was calculated utilizing the following formula:

$$MC\ \% = \frac{(W1)-(W2)}{W} x100$$

5) Determination of total ash

To calculate the total ash, 5 g of the sample were placed into a porcelain crucible previously weighed and incinerated overnight in a muffle furnace (N11, Nobertherm, Germany) at 550 C. After being removed from the muffle furnace, the crucible cooled in a desiccator and reweighted. The ash content then calculated using the following formula:

Ash (%) = (ash weight/sample weight) x 100

6) *Carbohydrate content*

The total carbohydrates were calculated using the following formula:

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

7) Energy value

The calorific energy value was determined according to the methods described in [29]. This was done by multiplying the percentages of carbohydrate, protein, and fat by the factors of 4, 4 and 9 respectively.

C. Mineral elements analysis *a.*

To conduct mineral elements analysis, 1 g of the dried plant material was transferred to a test tube. Then, 5 ml of concentrated nitric acid (HNO_3) was added. The mixture was placed to stand at least 1 hour to prevent frothing when the To conduct mineral elements analysis, 1 g of the dried plant material was transferred to a test tube. Then, 5 ml of concentrated nitric acid (HNO_3) was added. The mixture was placed to stand at least 1 hour to prevent frothing when the heat was applied, and 5 ml of HNO_3 were also added to an empty tube which served as blank. The mixture was placed on a hot plate with maintained at 120º C. After the mixture was heated for 1 hours, while the tube was still on the hot plate, 1 ml of 30% hydrogen peroxide was added carefully. The process repeated two times until a total of 3 ml of hydrogen peroxide were added to the mixture. The solution was heated until turned clear. After removal from the hot plate the tube was left to cool. The solution was passed through Whatman's No.1 filter paper to eliminate the insoluble particles. The final volume was brought to 50 ml with distilled water in a calibrated tube. An appropriate dilution was made for the sample before analysis. Potassium, calcium and sodium were determined using Flame Photometer (BWB Technologies, Newbury, UK) while the other mineral elements were determined using Atomic Absorption Spectrophotometer (AAS-Perkin Elmer, Model Analyst 800, Massachusetts, USA). The resulting solutions were analysed and the metal concentrations were determined based on values extrapolated from the calibration graphs, which were generated using standard metal solutions [10].

III. STATISTICAL ANALYSIS

The experimental measurements were carried out in triplicate are expressed as means ± standard deviation using Microsoft Excel 2013.

IV. RESULTS AND DISCUSSION

RESULTS

The results obtained in the present study quantified the nutritive value of the *C. coccineum* sample. The experiment was performed under standard laboratory conditions using standard protocols, and the results are presented in Table1.

TABLE1: PROXIMATE ANALYSIS OF *CYNOMORIUM COCCINEUM* L. STEM

Component	Mean value (%)
Crude protein	9.633 ± 0.205
Crude fat	1.656 ± 0.004
Crude fibre	3.073 ± 0.12
Total ash	5.276 ± 0.016
Moisture content	10.513 ± 0.026
Carbohydrate content	69.849 ± 0.074
Energy value	332.834±1.152 Kcal/g

Value are means ± Standard deviation of triplicate determination

In the present study, a total of eight elements calcium, potassium, sodium, manganese, iron, zinc, copper and cobalt were determined in the powdered sample of *C. coccineum.* The mean concentration of various metals in the plant sample is presented in Table 2.

TABLE 2: MINERAL ELEMENTS OF *CYNOMORIUM COCCINEUM* L. STEM

Mineral	Concentration(μg/g)
Calcium (Ca)	19940±53
Potassium (K)	13840±53
Sodium (Na)	2273±20
Manganese (Mn)	156±4.8
Iron (Fe)	124±7.7
Copper (Cu)	112±2.8
Zinc (Zn)	54±3.7
Cobalt (Co)	20±2.4

Value are means ± Standard deviation of triplicate determination

B. DISCUSSION

Poximent analysis: A one g sample of protein gives 4.0 kcal of energy. *C. coccineum* contains a significant portion of protein (9.633±0.205 %); the obtained value was similar to the protein content (9%) of the same plant in Sardinia, Italy, as reported by Zucca (2011) [11], while current data showed that the crude protein was lower than (28%) that reported by El-Tantawy (2002)[12]. This difference may be due to the fact that the protein content varies depending climatic and habitat conditions [13]. Foods that contain protein are essential for the human body entages of carbohydrate, protein, and fat by the factors of 4, 4 and 9 respectively**,** because they aid in building cells and tissue and they help repair tissues [14]. In the present study, only a small amount of crude fat (1.656± 0.004 %) was detected in the plant extract sample. In the literature, the crude fat concentration in wild *C. coccineum* samples has been reported to be 1.0 % in Sardinia and 9.359 % in Kuwait [11],[12]. The crude fibre content (3.073±0.12 %) the finding obtained in the current study disagrees with that presented by Zucca et al. (2016) (27.7 %) [11]. However, the crude fibre content (2.163%) that El-Tantawy (2002) reported for wild *C. coccineum* in Kuwait was nearly similar to as documented in the current study. Fibre is the part of the food that is not digested by humans. Therefore, the diet high in fibre may can cause intestinal irritation; however, normal functioning of the intestinal tract depends on the presence of suitable amount of fibre[15]. Carbohydrate were the principal component (69.849±0.074 %) in the sample used in the present study. In general, *C. coccineum* grown in Libya has a somewhat higher carbohydrate content than the carbohydrate content (45.5%) reported in the plant from Sardinia and in the plant from Kuwait (10.933 %) [11],[12]. Carbohydrates play a critical role in living organisms. They can be oxidized to yield energy, and their polymers serve as energy storage molecules [16]. The different climatic conditions might account for the variations in the fat, fibre, and carbohydrate content; the variations may also occur due to the different life stages in the plant [17]. Total ash content (5.276±0.016 %) was also obtained for *C. coccineum*. This result differs from the total ash content (14.191%) reported by El-Tantawy (2002) [11]. In general, ash content is considered an indicator of the mineral content in the original food [2]. A high quantity of moisture in nutrients makes them susceptible to microbial attack, and hence spoilage. Moisture content is commonly used as an indicator of product stability and susceptible to microbial contamination, and also as an indication of amount of water in the plant [18]. In the current study, the moisture content was (10.513±0.026 %). This means that the plant will most likely have a long shelf life due to its low moisture content. However, this result was significantly lower than (78. 667

%) that reported by El-Tantawy (2002) for the plants grown in Kuwait [11]. The energy value was determinted by multiplying the mean values of crude protein, crude fat and total carbohydrate by factors of 4, 9 and 4 respectively. The energy value was (332.834±1.152 Kcal) this value was higher than (281kcal) that recorded by Zucca et al.(2016),but the difference was not statistically significant[12]. This energy value suggests that the plant may be a potential source of energy for the human metabolism. The nutritional value of *C coccineum* appears to be compatible with human consumption, as described in traditional medicine [7].

Mineral analysis: Many researchers have investigated the mineral elements of several types of medicinal plants used in developing countries around the world. The mineral elements present in medicinal plants are very important in the formation of chemical constituents, because minerals are involved in plants metabolism and the chemical constituents of medicinal plants [19],[5],[20]. The calcium content (19940 53 g/g) was found in this plant. The calcium content in the current study is generally higher than that reported by El-Tantawy (2002) [11]. Calcium is one of the minerals necessary for growth and the maintenance of bones and muscles heaths [21]. The mean concentration of potassium in this study was (13840 g/g); this value differed from the previous result by El-Tantawy (2002) [11]. Absorption of potassium in the plant generally depends upon the type and characteristics of the soil [22]. The mean concentration of sodium was (2273 20 g/g). The sodium content was lower than that reported by El-Tantawy (2002) [11]. Besides maintaining the acid-base balance, sodium also contributes to the regulation of plasma volume, nerve impulses and muscle contraction [23]. In the human body, a numerous number of elements are required in small quantities to facilitate a wide range of functions; some these elements are manganese, iron, copper, zinc and cobalt. In this study, the mean concentration of manganese was (15 g/g). Manganese helps to uphold the immune system and energy production. In addition, it works with B-complex vitamin to regulate the effects of stress [24]. The level of iron in this plant was (124 g/g). Iron is necessary for the synthesis of hemoglobin in the red blood cells for oxygen transport around the body [25]. The mean concentration of copper was (112 2.8 g/g). Copper is a bioactive compound of many enzyme systems, such as cytochrome oxidase [25]. Copper may be toxic to humans when its level exceeds safe limits [26]. The recommended daily intake of copper required for children and adults 0.7 or 1.1 mg/day respectively [27]. The copper content in *C. coccineum* is however below the RDA. The mean concentration of zinc was determined to be (54 g/g). Zinc facilitates different reactions in the body that help to synthesis and protect DNA required for the growth and repair of body tissues [25]. Finally, the lowest mean concentration in this plant was recorded for the cobalt element (20 2.4 g/g). In the current study, the mean concentration of trace elements manganese, iron, copper, zinc and cobalt disagreed with the previous results reported by El-Tantawy (2002) for wild Kuwait *C. coccineum* [11]. The difference may be due to the fact that the content of elements and their various concentrations in the plants vary according to climatic conditions and soil fertility, along with the selectivity and absorbability of plants for the uptake of these elements. Hence, the variations in the concentrations of the elements are attributed to the character of the plants, furthermore as its surroundings [5],[3].

V. CONCLUSION

Information from the proximate and mineral analysis revealed that the *C. coccineum* stem has a long shelf life due to its low moisture content. Its high carbohydrate content makes it a good source of energy. It also serves as source of calcium, potassium and sodium. Therefore, this work provides information on the nutritional value of *C. coccineum* and its potential for use in nutraceutical formulations**.**

ACKNOWLEDGMENTS

The authors acknowledged to thank all the staff members of the Industrial Research Centre, Tajoura, Tripoli to help them.

REFERENCES

[1] G. Dastagir, F. Hussain, F. Khattak, and A. Khanzadi, "Proximate analysis of plants of family Zygophyllaceae and Euphorbiaceae during winter," *Sarhad J. Agric.*, vol. 29, no. 3, pp. 395-400, 2013.

[2] C. C. Isitue, M. J. Sanches-Muros Lozano, C. J. Jaramilio, and F. Dutan, "Phytochemical and nutritional properties of dried leaf powder of Moringa oleifera Lam. from Machalaeloro province of Ecuador," *Asian J. Plant Sci. Res.*, vol. 5, no. 2, pp. 8-16, 2015.

[3] M. A. C. Hannah and S. Krishnakumari, "Analysis of mineral elements, proximate and nutritive value in Citrullus vulgaris Schrad. (Watermelon) seed extracts," The Pharma Innovation J., vol. 4, no. 8, pp. 7-11, 2015.

[4] R. S. Lokhande, P. U. Singare, M. L. Andhele, R. Acharya, A. G. C. Nair, and A. V. R. Reddy, "Analysis of mineral content of some medicinal plants by NAA and AAS techniques," published in Radiokhimiya, vol. 51, no. 3, pp. 282-285, 2009.

[5] A. Bahadur, Z. Chaudhry, G. Jan, M. Danish, A. Rehman, R. Ahmad, A. Khan, S. Khalid, I. Ullah, Z. Shah, F. Ali, T. Mushtaq, and G. F. Jan, "Nutritional and elemental analyses of some selected fodder species used in traditional medicine," African J. Pharm. Pharmacol., vol. 5, no. 8, pp. 1157-1161, 2011.

[6] M. Hao-Cong, W. Shuo, L. Ying, M. Yuan-Yuan, and M.Chao-Mei, "Chemical constituents and pharmacologic actions of *Cynomorium* plants," Chinese J. Nat. Med., vol. 11, no. 4, pp. 321-329, 2013.

[7] R. W. Lebling, "The treasure of Tarthuth," J. Saudi Aramco World, vol. 54, no. 2, pp. 12-17, 2003.

[8] S. M. H. Jafri, Flora of Libya: Cynomoriaceae, vol. 17, Tripoli: University of Al-Fatah Press, 1977.

[9] AOAC, Official Methods of Analysis of AOAC International, 17th ed., Gaithersburg, MD, USA: Association of Analytical Communities, 2002.

[10] Y. P. Kalra, Handbook of Reference Methods for Plant Analysis, New York: Chemical Rubber Company Press, pp. 44-45, 1998.

[11] H. El-Tantawy, "The nutritional value of some desert plants in Kuwait, Arabian Peninsula," Taeckholmia, vol. 22, no. 1, pp. 35-45, 2002.

[12] P. Zucca, A. Argiolas, M. Nieddu, M. Pintus, M. Rosa, F. Sanna, F. Sollai, D. Steri, and A. Rescigno, "Biological activities and nutraceutical potentials of water extracts from different parts of Cynomorium coccineum L. 'Maltese mushroom'," J. Food Nutr. Sci., vol. 66, no. 3, p. 179, 2016.

[13] I. Hameed and F. Hussain, "Proximate and elemental analysis of five selected medicinal plants of family Solanaceae," Pakistan J. Pharm. Sci., vol. 28, no. 4, pp. 1203-1215, 2015.

[14] J. Y. Nehete, R. S. Bhambar, M. R. Narkhede, and S. Gawali, "Natural protein: Source, isolation, characterization and applications," Pharmacogn. Rev., vol. 7, no. 14, p. 107, 2013.

[15] M. C. Ojinnaka, E. N. Odimegwu, and F. E. Chidiebere, "Comparative study on the nutrient and anti-nutrient composition of the seeds and leaves of uziza (Piper guineense)," Int. Organ. Sci. Res. J. Environ. Sci. Toxicology Food Technol., vol. 8, no. 1, pp. 42-48, 2016.

[16] H. H. Hasan, I. H. Habib, M. H. Gonaid, and M. Islam, "Comparative phytochemical and antimicrobial investigation of some plants growing in Al-Jabal Al-Akhdar," J. Nat. Prod. Plant Resour., vol. 1, no. 1, pp. 15-23, 2011.

[17] S. Gupta, A. J. Lakshmi, M. N. Manjunath, and J. Prakash, "Analysis of nutrient and antinutrient content of underutilized green leafy vegetables," LWT - Food Sci. Technol., vol. 38, no. 4, pp. 339-345, 2005.

[18] A. O. Bolante, A. S. Funmilola, and A. Adedayo, "Proximate analysis, mineral contents, amino acid

composition, anti-nutrients and phytochemical screening of Brachystegia eurycoma Harms and Piper guineense Schum and Thonn.," Am. J. Food Nutr., vol. 2, no. 1, pp. 11-17, 2014.

[19] H. Abdalla and A. Dafalla, "Determination of the mineral contents of the roots of four medicinal plants as Sudanian indigenous plants using flame atomic absorption spectroscopy," J. Chem. Pharm. Res., vol. 6, no. 11, pp. 101-104, 2014.

[20] A. Kolasani, H. Xu, and M. Millikan, "Evaluation of mineral content of Chinese medicinal herbs used to improve kidney function with chemometrics," Food Chem., vol. 127, pp. 1465-1471, 2011.

[21] A. O. Ogbe and G. A. L. George, "Nutritional and anti-nutrient composition of melon husks: Potential as feed ingredient in poultry diet," Res. J. Chem. Sci., vol. 2, no. 2, pp. 35-38, 2012.

[22] B. Imelouane, M. Tahri, M. Elbastrioui, F. Aouinti, and A. Elbachiri, "Mineral contents of some medicinal and aromatic plants growing in eastern Morocco," J. Mater. Environ. Sci., vol. 2, no. 2, pp. 104-111, 2011.

[23] E. O. Akpanyung, "Proximate and mineral composition of bouillon cubes produced in Nigeria," Pakistan J. Nutr., vol. 4, pp. 327-329, 2005.

[24] A. Muhammad, S. M. Dangoggo, A. I. Tsafe, A. U. Itodo, and F. A. Atiku, "Proximate, minerals and anti-nutritional factors of Gardenia aqualla (Gauden dutse) fruit pulp," Pakistan J. Nutr., vol. 10, no. 6, pp. 577-581, 2011.

[25] M. Kumar, S. Dandapat, A. Kumar, and M. P. Sinha, "Determination of nutritive value and mineral elements of five-leaf chaste tree (Vitex negundo L.) and malabar nut (Adhatoda vasica Nees)," Acad. J. Plant Sci., vol. 6, no. 3, pp. 103-108, 2013.

[26] R. E. Abdolgader, A. A. Bellail, M. M. Mousa, and M. F. Abraheem, "Proximate and mineral contents in fruiting bodies of edible wild mushrooms from Al-Jabal Alakhdar province/Libya," Int. J. Sci. Res. Methodol., vol. 4, no. 3, pp. 123-147, 2016.

[27] J. O. Unuofin, G. A. Otunola, and A. J. Afolayan, "Nutritional evaluation of Kedrostis africana (L.) Cogn: An edible wild plant of South Africa," Asian Pac. J. Trop. Biomed., vol. 7, no. 5, pp. 443-449, 2017.

[28] P. Zucca, A. Rosa, C. I. Tuberoso, A. Piras, A. C. Rinaldi, E. Sanjust, M. A. Dessi, and A. Rescigno, "Evaluation of antioxidant potential of 'Maltese mushroom' *Cynomorium coccineum* L. by means of multiple chemical and biological assays," Nutrients, vol. 5, no. 1, pp. 149-161, 2013.

[29] S. H. Nile and C. N. N. Khobragade, “Determination of nutritive value and mineral elements of some important medicinal plants from western part of India,” Journal of Medicinal Plants, vol. 8, no. 5, pp. 79–88, 2009.

.,

.