A Comparative Study on Proximate and Mineral Composition of *Trigonella corniculata* and *Trigonella foenum-graecum* leaves

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***Abstract*:** Today, it has been a big challenge to provide safe, healthy and nutritious source of food for poor income group and undernourished population of the developing world. Due to scarcity, high cost and unreliable supply of healthy food in the developing and underdeveloped countries have resulted in the find out the cheap and alternative source of healthy and nutritious food. Some of the underutilized edible green leafy vegetables have been analyzed and found to possess high nutritional and therapeutic value. Thus, the present study examined the comparison on proximate and mineral composition of *Trigonella corniculeta* (kasuri methi) with *Trigonella foenum-graecum* (common methi) leaves. The proximate parameters moisture, ash, protein, fat, fiber content, and carbohydrate was calculated with difference method (100-moisture+ash+ fat +protein +fiber content) were performed by Association of official Analytical chemists standard methods whereas minerals content were carried out using an inductively coupled plasma optical emission spectrometer (ICP-OES) method. The present result showed that protein and fiber content of *T. corniculeta* were significantly increased ($p<0.05$) by 23.61% and 12.73% respectively when compared to *T. foenum-graecum*. The mineral analysis also revealed that *T. corniculeta* had significantly increased calcium and iron content ;1196.97±1.02 and 40.83 ±0.16 mg/100g respectively. The present study revealed that, the leaves of *T. corniculeta contain appreciable amount of protein*, fiber, iron and calcium content. Despite the fact that it is a lesser known leafy vegetable, has massive nutritional potentials as common methi and could be favourably used as a substitute for most of the commonly used vegetables.

***Index Terms*-** Green leafy vegetables, *Trigonella corniculeta, Trigonella foenum-graecum*, proximate and mineral composition.

I.INTRODUCTION

Vegetables play an important role in human diets as they support the normal functioning of the different body system (Duma *et al*; 2014) and are the key component to provide macro and micro nutrients and antioxidants content. Particularly leafy vegetables plays significant role in alleviating micronutrient deficiency. Recently, a lot of interest has been focused to evaluate various lesser known vegetables because they serve as an indispensable constituent of human diet replenishing the body with certain hormone precursors, in addition to protein and energy content. Many of the green vegetables are under-exploited as a result of inadequate knowledge for utilization and lack of awareness about their nutritional and medicinal potentials (Seal, *et al*; 2017). These underutilized vegetables are -*Moringa oleifera, Ipomoea aquatic, Basella alba , Amaranthus cruentus* etc. which are inexpensive, easy to cook and packed with phytonutrients including minerals which are essential for the metabolic process and protection of our body as well. A good number of such underutilized leafy vegetables are hidden source of proteins, vitamins and dietary fibres. These are embedded with neutraceuticals as well as pharmaceuticals components which are essential for human well being (Deb *et al*; 2013).

Fenugreek commonly known as methi belongs to the *Fabaceae* family is cultivated throughout India. The two varieties of fenugreek are *Trigonella foenum-graecum* (common methi*)* and *Trigonella corniculata* (Kasuri methi). Both varieties differ in their growth habit and yield. Out of all available varieties of fenugreek, *T corniculata* is different in phenotypic characteristics, flavour, leaf sizes, fragrance and seed size (Chaudhary and Chaudhary, 2019). It is slow growing and remains more or less in a rosette condition during most of the vegetative period. Its flowers are bright orange- yellow in clusters in close racemes and leaves are pinnate and consist 2-6 leaflets each upto 1.25-2.0 cm in length. It is diffuse, sub-errect, strongly scented annual herb about 30 cm or more in height (Aslam, 2009). It is known for its appetizing fragrance and has its origin in the Kasur district provience of Pakistan and thus has its name 'Kasuri methi'(Erum *et al*; 2011). It is used as flavouring agent and also known as protective

food which reflects its significance in supplying of vital nutrients for good health (Singh *et al*;2019).The *T foenum-graecum* is condiment crop grown in southern and Northern India like-Rajasthan, Haryana, Punjab and Uttar Pradesh Nandre *et al*; (2011). It produces upright shorts, an aromatic, annual herb about 30-60 cm tall and produces upright shorts, an aromatic, annual herb about 30-60 cm tall .Its flowers are white-yellow in colour and leaves are pinnate, trifoliate light green in colour about 2.0-2.5 cm long and its seeds are about 0.3-0.5 cm long (Basu, 2006). Its leaves and young pods are used as vegetables and their seeds as condiments. It is quite rich in protein, minerals and vitamin C and has also some medicinal value which prevents constipation, removes indigestion, stimulates the spleen and the liver and is appetizing and diuretic (Shrivastava, 2017). Both varieties of fenugreek are the most promising known for its functional and nutraceutical properties such as-antibacterial, anticancer, antiulcer, hypocholesterolmic, hypoglycaemic, antioxidants and antidiabetic agent (Meghwal and Goswami, 2012). Therefore, this study was aimed at determining and comparing the proximate and minerals composition of both varieties of fenugreek leaves.

II. MATERIALS AND METHODS

2.1Collection and identification of plant materials

The fresh leaves of both varieties of fenugreek were collected from Nagour, Rajasthan and were identified by a plant taxonomist of Horticulture department of Nagour University. The fresh leaves were washed under tap water and spread on a filter paper for 2 hrs to drain the excess water from the leaves and then dried at room temperature for 7 hrs daily till the leaves attained constant weight after which it was reduced to coarse powder by blender it stored in airtight container for further analysis.

2.2Proximate and Mineral analysis

Proximate analysis was carried out in accordance with Association of Official Analytical Chemists (2012). This constitutes the different classes of nutrients present in the samples such as moisture content was determined by drying in an oven at 105 °C until constant weight was obtained. Ash content was determined by the incineration of a dried powdered sample 5 g in a muffle furnace at 600 °C for 6 hrs until the ash turned white. The protein was estimated by the micro kjeldahl method. The fat was estimated by ether extraction method by using soxhlet apparatus. Crude Fibre was determined by acid alkali digestion by using fibre tech. Carbohydrates were calculated using difference method by subtracting the protein, fibre, moisture, fat and ash content from 100. Minerals analysis was carried out using an inductively coupled plasma optical emission spectrometer (ICP-OES) for Iron, zinc, calcium, copper, potassium, sodium and magnesium contents.

2.3Statistical Analysis

The data was expressed as Mean ± Standard Deviation and Paired t-Test of three determinations and also statistically analyzed to ascertain its significance at $P \leq 0.05$ level.

III. RESULTS AND DISCUSSION

Table 1: Nutritional composition of *Trigonella corniculata* and *Trigonella foenum-graecum* leaves on dry weight basis

Parameters (g/100g)	*Trigonella corniculata*	*Trigonella foenum-graecum*	Percent decreased & increased
Moisture	5.16±0.80	5.65±0.50 $^{(NS)}$	(6.90%)
Ash	9.13±0.26	8.43±0.41 *	(12.3%)
Protein	23.61±1.34	24.55±1.31 *	(3.82%)
Fat	3.67±0.50	3.49±0.40 $^{(NS)}$	(5.15%)
Fibre	12.73±0.72	11.28±0.20 *	(12.85%)
Carbohydrates	45.66±0.21	47.20±0.26 *	(3.26%)

Values are expressed as Mean ±SD of triplicate determinations
* Shows significant difference; and ^{NS} shows non-significant difference at ($p<0.05$) level
Data in parenthesis is % Increased and Decreased

Vegetables play a significant role in human nutrition, apart from the fact that we obtain most of our recommended daily needs of minerals and vitamins from them, they also supply certain constituents in which other food materials are deficient. The wide variations in colour, taste and texture of various vegetables have added an interesting touch to meals. The cultivation and consumption of green leafy vegetables cuts across different races because if their nutritional and health benefits. They have been shown to reduce the risk of degenerative diseases such as cancer, diabetes and cardiovascular disease (Kavitha and Ramadas, 2013).

The proximate analysis for moisture, ash, protein, fat, fibre, carbohydrate content as depicted in table 1. Low moisture content is encouraged to safeguard the products from microbial attack and enzyme action which may prevent spoilage (Akonor *et al*; 2016). The moisture content (g/100g) of *T. corniculata* and *T. foenum-graecum* leaves were 5.16±0.80 and 5.65±0.50 respectively. This data illustrate that *T. corniculata* had non- significant decreased moisture content by 6.90% as compared to *T. foenum-graecum* at $p<0.05$ level. Similar data predicted by Pasricha and Gupta (2014) that the *T.corniculata* had 5.22g/100g moisture content and according to Chaturvedi *et al*; 2013 that *Spinacia oleracea* leaves also contain moisture content of same value i.e 5.68±0.08g/100g. Ash content is directly proportional with inorganic elements content of legumes. The samples with high percentage of ash contents are expected to have high concentration of various mineral elements, which are advantage to speed up metabolic processes which may improve growth and development (Fekadu *et al*; 2013). *T. corniculata* leaves had 9.13±0.26g/100g of ash content which was increased by 12.3% at $p<0.05$ level as compared to *T. foenum-graecum*. Likewise, Akindahunsi and Salawu, (2005) that *Hibiscus esculentus* leaves had 8. 1% of ash content which is an agreement to the present study.

It's worth précising that plant foods which provide more than 12 % of their calorific value from proteins have been shown to be good source of proteins (Ali, 2009).The protein content (g/100g) of *T. corniculata* and *T. foenum-graecum* were 23.61±1.34 and 24.55±1.31 respectively. The data shows that *T. corniculata* was significantly decreased by 3.82% when compared to *T. foenum-graecum* leaves at $p< 0.05$ level. The result obtained comparably higher with the leaves of *Momordica balsamia* 11.29%, *Lesianthera africana* 14.91% reported by Hassan and Umar, (2006). Likewise similar data was observed by Antia *et al*; (2006) that *Amranthus candatus, I.batatas* leaves had 20.5% and 24.85% protein content. Fat are the major source of energy but should be consumed with caution to avoid obesity and other related diseases. It's important that diet providing 1 – 2 % of its caloric energy as fat is said to be sufficient to human beings, because low fat content would favour prevention of metabolic disorders (Kris-Etherton *et al*; 2002). Fat content (g/100g) of *T. corniculata* and *T. foenum-graecum* were 3.67±0.50 and 3.19±0.40 respectively. The data shows that *T.corniculata* leaves had insignificant increased value by 5.15% at $p< 0.05$ level. Similar data was reported by Yisa *et al*; 2010 that *Talinum triangular* leaves had 5.90g/100g fat content. Likewise, the study reported by Saha *et al*; 2015 that leaves of *Brassica nigra* had 4.19±0.05 fat content which is an agreement with the obtained data.

Intake of fibre may lower the serum cholesterol level and chances of having the risk of coronary heart disease, hypertension, constipation, diabetes, colon and breast cancers (Prasad and Singh, 2015). Fibre content (g/100g) of *T. corniculata* was 12.73±0.72 which was significantly increased by 12.85% when compared with *T. foenum-graecum* leaves at $p< 0.05$ level. The present data was comparable to the data given by Onwordi *et al*; 2009 that *Celusia argenta* had 11.70±0.80g/100g of fibre content. Looking at the results of carbohydrate content of *T.corniculata* leaves had significant decreased by 3.26% when compared with *T. foenum-graecum* leaves at $p<0.05$ level. The result obtained compared favourably with leaves of *Brassica oleracea* and *Urtica urens* with value of43.27g/100g and 44.59g/100g respectively (Lewu and Kambizi ; 2015).

Mineral composition

Table 2: Minerals composition of *Trigonella corniculata* and *Trigonella foenum-graecum* leaves on dry weight basis

Minerals (mg/100g)	*Trigonella corniculata*	*Trigonella foenum-graecum*	Percent decreased & increased
Calcium	1196.97±1.02	1098.80±1.66 *	(8.93%)
Iron	40.83±0.16	29.01±0.63 *	(40.74%)
Zinc	4.11±0.95	4.96±0.94 ^{NS}	(17.13%)
Potassium	1286.37±2.55	1764.40±1.45 *	(27.09%)
Sodium	1493.04±3.63	2409.80±3.73 *	(38.04%)
Copper	1.11±0.40	0.96±0.14 *	(15.62%)

Magnesium	435.28±4.05	450.10±3.06 ^{NS}	(3.29%)

Values are expressed as Mean ±SD of triplicate determinations
* Shows significant difference and; NS shows non-significant difference at (P < 0.05) level
Data in parenthesis is % Increased and Decreased

The mineral contents of *T. corniculata* and *T. foenum-graecum* are presented in Table 2.Calcium is an important mineral for human beings, which provides good strength of bones and teeth (Turan *et al*; 2003). Calcium content (mg/100g) of *T. corniculata* and *T. foenum-graecum* were 1196.97±1.02 and 1098.80±1.66 respectively which showed that *T. corniculata* had significant increased by 8.93% at p<0.05 level in comparison to *T. foenum-graecum* leaves. The result of present study was compared favourably to the leaves of *Leucas aspera* and *Gynandropsis pentaphylla* which had calcium content 1147.30 mg/100g and 1113.10mg/100g respectively (Pattan and Devi, 2014). According to Geissler and Powers (2005), iron has been reported as an essential trace metal and plays numerous biochemical roles in the body, including oxygen binding in haemoglobin and acting as an important catalytic center in many enzymes as the cytochrome oxydase. The result obtained for iron content (mg/100g) was significantly increased by 40.74% in *T. corniculata* leaves (40.83±0.16) as compared to *T. foenum-graecum* leaves (29.01±0.63) at p<0.05 level this data is comparable with the study reported by Karmakar *et al*; 2013 that *Bottle gourd* leaves and *Chickling pea* leaves had iron content 38.1 ±1.1 and 42.76±0.8 respectively.
Sodium and potassium are important intracellular and extracellular cations respectively, which are involved in the regulation of plasma volume, acid-base balance, nerve and muscle contraction (Akpanyung, 2005). Sodium and potassium content of *T corniculata* were 1493.04±3.63 and 1286.37±2.55mg/100g respectively which showed that *T. corniculata* was significanty decreased by 38.04% and 27.09% at p<0.05 level when compared to *T. foenum-graecum*. The results obtained comparably higher as contrast to *Ipomoea batatas* and *kale* leaves as 750mg/100g and 491mg/100g reported by Taiye and Berko, 2001; Sanlier and Guler, 2018. According to findings, the sodium to potassium ratio of less than one has been recommended for the prevention of high blood pressure (Patricia *et al*; 2014).
Magnesium is known to prevent cardiomyopathy, muscle degeneration, growth retardation, alopecia, dermatitis, immunologic dysfunction, gonadal atrophy, impaired spermatogenesis, congenital malformations and bleeding disorders (Chaturvedi *et al*; 2004). The result obtained for magnesium content (mg/100g) was insignificantly decreased in *T corniculata* (435.28±4.05) when compared to *T. foenum-graecum* leaves (450.10±3.06) by 3.29% at p<0.05 level. The similar result stated by Suganya *et al*; (2017) that of the leaves of *Beta vulgaris* contained 350.50mg/100g mg content**.** Copper and Zinc are the essential trace elements that are needed only in one minute amounts by the human body for important biochemical functions. The levels of copper and zinc are closely interrelated. Zinc stimulates the synthesis of metallothionein. Metallothionein has a high affinity for copper and it hinders copper systemic absorption within the intestinal cells (Osredkar and Sustar, 2011).Copper content (mg/100g) was 1.11±0.40 in *T. corniculata* which was significantly increased by 15.62% when compared with *T. foenum-graecum* 0.96±0.14 at p<0.05 level. The data was comparable with the study reported by Saha *et al*, (2015) that *Diplazium esculentum* had 1.70 ± 0.20mg/100g of copper content. Zinc content (mg/100g) of *T. corniculata* and *T. foenum-graecum* leaves were 4.11±0.95 and 4.96±0.94 respectively. The data predicted that *T. corniculata* was insignificantly decreased by 17.13% at p<0.05 level with the comparison of *T. foenum-graecum* leaves. The zinc value reported by Emebu and Anyika, (2011) that leaves of *Brassica oleracea* contain 2.16mg/100g and likewise, Shils *et al*, (2006) stated that *Afia nkukwo leaves* contain 3.81mg/100g of zinc content.

CONCLUSION

From the results of the study, it is comprehensible that *T. corniculata* had significant high content of protein, fibre, calcium and iron content when compared to *T. foenum-graecum*. Though, it is a lesser known leafy vegetable but has enormous nutritional potentials and could favourably be used as a substitute for most of the commonly used vegetables. It has great nutritional importance which may facilitate to reduce high glucose and cholesterol level consequently assist in the prevention of various metabolic diseases.

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