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Physicochemical properties of ginger (*Zingiber officinale*), lemon grass (*Cymbopogon citratus*) and tulsi (*Ocimum gratissimum*)

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Abstract

India has been well known all over the world for spices and medicinal plants and herbs. Spice plants and herbs exhibit a wide range of physiological and pharmacological properties. Current biomedical efforts are focused on their scientific merits, to provide science-based evidence for the traditional uses and to develop either functional foods or nutraceuticals. Plants are utilized as therapeutic agents since time immemorial in both organized (Ayurveda, Unani) and unorganized (folk, tribal, native) form. Plants have been identified as the potent therapeutic agent, due to the presence of nutritional (minerals and vitamins) and non-nutritional component (fibres, active phytochemicals), including the flavonoids, terpenoids, lignans, sulfides, polyphenolics, carotenoids, etc.), due to promoted as “functional food”. Ginger, lemon grass, tulsi provides a rich amount of Fe, Zn, Ca, Mg, Na, K, P, Cu and Mn. And also significant amount of vitamin B1, B2, B3 and C. So as concluding remark Ginger, lemon grass and tulsi all are good cardiovascular health, brain health and human body, various pharmacological activities such as anti-amoebic, anti-bacterial, anti-diarrheal, anti-filarial, anti-fungal and anti-inflammatory properties and various other effects like anti-malarial, anti-mutagenicity, anti-mycobacterial, anti-oxidants, hypoglycemic and neurobehavioral.

Keywords: Functional foods, nutraceuticals, fat, moisture, protein, carbohydrate

Introduction

Despite the many wonders of science and industry, modern life is fraught with stress. (Joseph LJ, *et al.*, 2011). We are in the midst of a global pandemic of obesity, diabetes, cancer, dementia, depression and other chronic diseases caused by modern lifestyles and their associated lack of physical activity, high intake of sugar, fat, salt, alcohol and tobacco and exposure to a toxic cocktail of industrial chemicals. (Cohen MM, 2014) [17].

In modern era, large number of researchers have focused and showed interest into medicinal herbs and plants due to increase in demand of spice and healthy foods (Singh RP. *et al.*, 2017) [22]. Herbs and spices have been used for ancient time, in cooking and medicine (Sharma M. *et al.*, 2017) [19]. They provide a wide range of flavors to food and also increase health benefits (Cantwell, 2001) [6], multirole medicinal plants such as ginger, cumin, caraway, anise, fennel, curcumin, black seed, olive fruits/leaves and dates and their constituents used to cure various diseases via modulation of biological activities (Tejndraputra E., *et al.*, 2001) [23]. Medicinal plants have been important source of natural products and by products for a long period of time to maintain human health, especially with more intensive studies in the last few decade for natural therapies (Gislene *et al.*, 2000) [10]. Herbs and spices have been used not only for flavor, taste and aroma of the foods but also contain antimicrobial properties (Nanasombat *et al.*, 2002) [16]. Spices including Clove (*Eugenia caryophyllus*), Black pepper (*Piper nigrum* L.) Turmeric (*Curcuma longa*) and Ajwain (*Trachyspermum ammi*) provide defence against pathogenic bacteria. Spice also recognized as natural food preservative and medicinal values due to bioactive antimicrobial compounds (Wang and Weller, 2006) [24]. (Shelef, 1983; Sharma M. *et al.*, 2017) [20, 19]

Ginger belongs to the Zingiberaceae family, has been discovered more than 2500 years back that grown in warm climates of India, China and Jamaica (Singh RP *et al.*, 2017) [22]. *Zingiber officinale* (Ginger) is a tropical and subtropical cultivated plant, closely related to other spice plants such as cardamom (*Elettaria cardamomum*) (Leung AY *et al.*, 1996) [14].

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Which is widely used as a culinary spice and in traditional medicines, to add flavor in food stuffs for more than thousands of years, also used in pharmaceuticals, nutraceuticals and in cosmetics products. Ginger contains a combination of an aromatic oils both volatile and non-volatile oils and phenolic compounds.

Lemon grass *Cymbopogon citratus* is an aromatic tropical perennial tall (Plant) grass with rhizomes and densely tufted fibrous root which yields aromatic oil. The name lemongrass is derived from the typical lemon-like odour of the essential oil present in the shoot. It has short underground stems with ringed segments, coarse, green slightly leathery leaves in dense clusters (Carlin *et al.* 1986). The plant is a native herb from India (Originated in Asia and Australia) and is cultivated in other tropical and subtropical countries. (Figueirinha *et al.* 2008) [8]. Lemongrass was one of the herbs to travel along the spice route from Asia to Europe. (Francisco *et al.* 2011). Several reports have linked its origin to Asia (Indochina, Indonesia and Malaysia), Africa and the Americas. There are several species of lemon grass such as *Cymbopogon bombycinus*, *Cymbopogon ambiguus*, *Cymbopogon obtectus*, *Cymbopogon refractus*, *Cymbopogon citrate*, *Cymbopogon nardus*, *Cymbopogon schoenanthus* etc found in countries such as Australia, China, India, Africa and others Countries (Prince *et al.* 2018).

Tulsi is an aromatic shrub from basil family Lamiaceae. In Sanskrit Tulsi means “One that is incomparable or matchless” (Bhateja S. *et al.*, 2012). Tulsi has two varieties-Black and green which is called as Krishna Tulsi (*Ocimum sanctum* L) and Ram Tulsi (*Ocimum gratissimum*) respectively. In Ayurveda “Mother Medicine of Nature” and “The Queen of Herbs,” for both its medicinal and spiritual properties (Bast F. 2014) [4]. In India, tulsi has been adopted for spiritual rituals and lifestyle practices that provide a vast array of health benefits that are just beginning to be confirmed by modern science (Mahajan N. 2010). This emerging science on tulsi, which reinforces ancient Ayurvedic wisdom, suggests that tulsi is a tonic for the body, mind and spirit that offers solutions to many modern day health problems (Cohen MM, 2014) [7]. Tulsi leaves are widely used due to their healing power, tonic for the nervous system and thus, helps a great deal in sharpening the memory. Tulsi helps in the removal of phlegm and catarrhal matter from the bronchial tube. It also works great in preventing stomach disorders, respiratory disorders. The decoction prepared by mixing honey, ginger and Tulsi leaves is quite helpful in combating bronchitis, influenza and asthma (Kumar KPS. *et al.*, 2020).

Material and Methods

Tulsi, Ginger and Lemon Grass were collected from local market. Moisture content of quinoa flakes and corn flakes were determined by oven method described in Prince., *et al.*, 2018 [17, 18] and AOAC (1990) [4]. Crude protein was determined by the Kjeldahl nitrogen method described in AOAC (1990) [4]. Fat content was determined by the soxhlet extraction method described in AOAC (1990) [4]. Ash was determined by AOAC (1995) [5] method. A 2g sample was ignited at 600 °C in a muffle furnace for 6 hours. The residue was cooled in a desicator and weighed. Crude fiber was determined by AOAC (1995) [5] method. Carbohydrate and energy were calculated by calculation method Kent (1963) [20], Koziol (1992) [21].

Vitamin A content was determined by the HPLC (AACC, 1995) [3]. Vitamin E (α -tocopherol) content was determined by the high performance liquid chromatography (HPLC)/

fluorescence method described by Miranda *et al.* (2010) [25]. Furthermore, vitamin B1 (thiamine), B2 (riboflavin), B3 (niacin) and B5 (pantothenic acid) were determined by acid and enzymatic hydrolysis, separated with HPLC (AACC, 1995) [3]. Fatty acids were determined by IS: 548. Mineral elements (Na, K, Ca, Mg, Cu, Mn, Zn, and Fe) were measured with inductively coupled plasma (Spectrophotometer) method (AOAC 1995) [5].

Statistical Analysis

The entire experiment was replicated three times. All the data were analyzed by excel and results were expressed as mean \pm standard deviation (SD).

Results and Discussion

Ginger (Table. 1) contains 1.02 g/100g of ash, 98.23 g/100g of moisture which is higher than 78.9 g/100g (Singh RP. 2017) [22], 0.48 g/100g of fat found but 750 mg/100g of fat was reported by Singh RP. 2017 [22], 0.02 g/100g of protein which is lower than 1.8 g/100g (Singh RP., *et al.*, 2017) [19], crude fiber were not recorded during the analysis and 0.22 g/100g of carbohydrates but 18 g/100g of fat was reported by Singh RP. 2017 [22]. Ginger provide 5.40 Kcal/100g of energy. Nutritional analysis (Table. 1) of Lemon Grass presents 1.11 g/100g of ash, 98.34 g/100g of moisture, 0.35 g/100g of fat, 0.03 g/100g of protein, crude fiber were absent during analysis and 0.17% of carbohydrates. The amount of energy is provided by Ginger are 3.99 Kcal/100g. Proximate analysis (Table. 1) of Tulsi presents 1.02 g/100g of ash, 98.37 g/100g of moisture, 0.45 g/100g of fat, 0.04 g/100g of protein 0.02 g/100g crude fiber and 0.11% of carbohydrates. The amount of energy is provided by Tulsi are 4.67 Kcal/100g. According to Bhooshitha AN., *et al.*, 2020 tulsi provides 0.64 g of fat, 3.15 g of protein, 2.65 g of carbohydrates, 0.0 mg of cholesterol, 1.60 g of dietary fiber and 23 Kcal of energy. Results show that quinoa flakes is higher in nutritional values like fat, protein, crude fiber and energy than corn flakes, so its batter than the corn flakes.

Table 1: Proximate analysis of Ginger, Lemon grass and corn Tulsi (g/100g)

S. No.	Parameter	Ginger	Lemon Grass	Tulsi
1	Ash	1.02 \pm 0.01	1.11 \pm 0.05	1.02 \pm 0.02
2	Moisture	98.23 \pm 0.06	98.34 \pm 0.04	98.37 \pm 0.03
3	Fat	0.48 \pm 0.00	0.35 \pm 0.01	0.45 \pm 0.06
4	Protein	0.02 \pm 0.00	0.03 \pm 0.00	0.04 \pm 0.01
5	Crude Fiber	0.00 \pm 0.00	0.00 \pm 0.00	0.02 \pm 0.00
6	Carbohydrate	0.22 \pm 0.05	0.17 \pm 0.08	0.11 \pm 0.03
7	Energy (Kcal)	5.40 \pm 0.20	3.99 \pm 0.34	4.67 \pm 0.49

Lemon grass (Table. 2) contains 0.01 g/100g of saturated fatty acids, 0.09 g/100g of mono saturated fatty acids and 0.14 g/100g of poly saturated fatty acids. Lemon grass provide 0.32 g/100g of total fatty acids. The results provided by the study presented that the Ginger and Tulsi (Table. 2) does not contain rich amount of crude fat but some results were shown by Singh RP. *et al.*, 2017 [22] 203 mg/100g of saturated fatty acids, 154 mg/100g of mono saturated fatty acids, and 154 mg/100g of poly saturated fatty acids. Ginger provide 750 mg/100g of total fatty acids. Results shown that Lemon grass is higher in fatty acids values like mono saturated fatty acids and poly saturated fatty acids than amount found in Tulsi and Ginger. Rich amount of mono saturated fatty acids and poly saturated fatty acids is good for cardio vascular health of human.

Table 2: Fatty acid analysis of Ginger, Lemon grass and corn Tulsi (g/100g)

S. No.	Parameter	Ginger	Lemon Grass	Tulsi
1	SFA	NR	0.10 ± 0.01	NR
2	MUFA	NR	0.09 ± 0.01	NR
3	PUFA	NR	0.14 ± 0.01	NR
4	TFA	NR	0.32 ± 0.02	NR

As per results comes in study Ginger, (Table. 3) contains 5.16 mg/100g of iron, 1.52 mg/100g of zinc, 34.30 mg/100g of calcium, 85.36 mg/100g of magnesium, 15.62 mg/100g of sodium, 571.44 mg/100g of potassium, 45.35 mg/100g of phosphorus, 1.27 mg/100g of copper, and 11.16 mg/100g of manganese. Singh RP., *et al.*, (2017) [10] reported that Ginger contain potassium 415 mg/100g, sodium 13 mg/100g, zinc 340 mcg/100g, copper 226 mcg/100g, manganese 229 mcg/100g (83.33mg/100g).

The results provided by the study presented that the lemon grass (Table. 3) contains 7.00 mg/100g of iron, 2.01 mg/100g of zinc, 54.08 mg/100g of calcium, 50.57 mg/100g of magnesium, 4.95 mg/100g of sodium, 621.27 mg/100g of potassium, 87.88 mg/100g of phosphorus, 0.18 mg/100g of copper, and 5.09 mg/100g of manganese. According to Table. 3 Tulsi contains 11.53 mg/100g of iron, 10.63 mg/100g of zinc, 4.25 mg/100g of calcium, 0.65 mg/100g of magnesium, 71.11 mg/100g of sodium, 981.91 mg/100g of potassium, 4.00 mg/100g of phosphorus, 1.05 mg/100g of copper, and 6.68 mg/100g of manganese.

Results show that Tulsi is higher in iron, zinc, potassium. But calcium, phosphorus content found higher in Lemon grass and manganese and copper were rich in Ginger. Rich amount of mineral is good for muscle and neurological health of human and also good for heart.

Table 3: Mineral analysis of Ginger, Lemon grass and corn Tulsi (mg/100g)

S. No.	Parameter	Ginger	Lemon Grass	Tulsi
1	Fe	5.16 ± 0.06	7.00 ± 0.15	11.53 ± 0.36
2	Zn	1.52 ± 0.08	2.01 ± 0.07	10.63 ± 0.38
3	Ca	34.30 ± 0.69	54.08 ± 1.39	4.25 ± 0.21
4	Mg	85.36 ± 0.45	50.57 ± 0.34	0.65 ± 0.17
5	Na	15.62 ± 0.41	4.95 ± 0.07	71.11 ± 0.89
6	K	571.44 ± 2.78	621.27 ± 1.84	981.91 ± 1.44
7	P	45.35 ± 0.79	87.88 ± 1.38	4.00 ± 0.13
8	Cu	1.27 ± 0.19	0.18 ± 0.02	1.05 ± 0.07
9	Mn	11.16 ± 0.39	5.09 ± 0.14	6.68 ± 0.11

Ginger (Table. 4) according to the results it provides 2.29 mg/100g of vitamin A, 0.31 mg/100g of vitamin B1, 0.22 mg/100g of vitamin B2, 2.94 mg/100g of vitamin B3, 0.29 mg/100g of vitamin B5, 4.15 mg/100g of vitamin C and 0.18 mg/100g of vitamin E. The results provided by the study Lemon grass (Table. 4) 5.15 mg/100g of Vitamin B1, 0.86 mg/100g of Vitamin B2, 0.11 mg/100g of Vitamin B3, and 2.10 mg/100g of Vitamin C. During the study it is observed that Tulsi do contain 0.26 mg/100g of vitamin A, 0.06 mg/100g of vitamin B1, 0.08 mg/100g of vitamin B2, 0.88 mg/100g of vitamin B3, 0.18 mg/100g of vitamin B5, 15.72 mg/100g of vitamin C and 1.01 mg/100g of vitamin E.

According to Prince. *et al.*, 2018 [17, 18] lemongrass contains an excellent source of vitamins. They are vitamin A, vitamin E, vitamin B1, B2, B3, B5, B6 and vitamin C (Kumar *et al.* 2000) [13]. Vitamin C aids in wound healing and also helps in resisting infection. Its deficiency can cause scurvy (characterized by bleeding gum, poor healing of wound and

low resistance to infection) (Geetha and Geetha 2015) [9]. The recommended dietary allowance of vitamin C is 45 mg per day (WHO, 1991) [25]. There is an increasing body of evidence that natural antioxidants such as vitamin C and E protect the body against a number of degenerative diseases such as atherosclerosis, aging and certain types of cancer. The substantial level of these molecules in lemongrass leaves is indicative of the plant nutritional and medicinal significance. According to USDA reported that Lemongrass contains 27 IU of Vitamin A 0.016 mg/100gm. Potassium is the principal cation in intracellular fluid and functions in acid-base balance, regulation of osmotic pressure, conduction of nerve impulse, muscle contraction particularly the cardiac muscle, cell membrane function. Zinc boosts the immune system and act as antioxidant (Ferguson *et al.* 1993).

Table 4: Vitamin analysis of Ginger, Lemon grass and corn Tulsi (mg/100g)

S. No.	Parameter	Ginger	Lemon Grass	Tulsi
1	Vitamin A	2.29 ± 0.15	5.15 ± 0.10	0.26 ± 0.00
2	Vitamin B1	0.31 ± 0.01	0.86 ± 0.03	0.06 ± 0.03
3	Vitamin B2	0.22 ± 0.02	0.11 ± 0.02	0.08 ± 0.02
4	Vitamin B3	2.94 ± 0.12	1.05 ± 0.06	0.88 ± 0.12
5	Vitamin B5	0.28 ± 0.01	NR	0.18 ± 0.02
6	Vitamin C	4.15 ± 0.07	2.10 ± 0.13	15.72 ± 0.52
7	Vitamin E	0.18 ± 0.03	NR	1.01 ± 0.23

Conclusion

Thus in light of experimental data and scientific data it may be concluded that ginger, lemon grass and tulsi are very interesting medicinal herbs because of its nutritional characteristics. It has been recognized Using herbs and spices is a great way to reduce sodium, sugar, and fat in your diet while adding bold new flavors. It is a good idea to plan your meals before going to the grocery store so that you know which herbs and spices you will need. The diversity of their cellular actions supports their possible beneficial effects on various chronic diseases. More rigorous clinical trials are needed to determine long-term benefits. The integration of knowledge is required to determine their effect in natural human settings. Food based approaches for enhancing the intake of spices and photochemical can offer an avenue to greatly impact the onset and progression of chronic diseases, oxidant stress and ageing. Although the chemo preventive approach is a recognized strategy, public health action should be directed at increases in the consumption of foods / herbs / spices / beverages, which possess a package of protective phytonutrients. It is also rich in iron, zinc, calcium, magnesium, potassium, phosphorus and provides crude fiber, vitamin A, vitamin E as well as some vitamin B complex along with vitamin C.

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