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Value addition in biscuits with the supplementation of *Hibiscus rosa-sinensis* leaves powder

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Abstract
In India, hibiscus leaves are used to treat various diseases and are a part of Indian folk medicine. In southern India, leaves are crushed and applied to hair to stimulate hair growth and improve hair blackness. Herbal medicine is the oldest form of healthcare known to mankind. Herbs had been used by all cultures throughout history. As a consequence of reliable experience from the past generations, today, the whole world and all cultures have extensive knowledge about herbal medicines. Hibiscus apart from their ornamental value in India. *Hibiscus rosa-sinensis* has a cultural value. *Hibiscus rosa-sinensis* is the major flower offered to the goddess 'Kali' (Gupta, 1971). The glory of the rising sun in Indian literature is often compared to the comparatively beautiful flower.

Keywords: Hibiscus Rosa-Sinensis, value-added products, organoleptic, nutritional composition

Introduction
Hibiscus rosa-sinensis is an edible flower "The edible flower is termed as innocuous and non-toxic flowers with many health benefits included in human diet" (Lu, *et al.* 2016) [18]. Edible flowers have unique and powerful flavour, colour and aroma and therefore have gained popularity in the culinary world as an innovative ingredient (Jadhav, *et al.* 2009). *Hibiscus rosa-sinensis* has innumerous applications. The flowers of this plant are employed to develop a famous beverage in Egypt and are also used to formulate medicines. Different parts of the plant are also added in the development of jams, spices, soups and sauces. In foods and beverages, *hibiscus rosa-sinensis* is mostly used as a taste enhancer. It is additionally used to enhance the odour and appearance in multiple recipes. In Akwa Ibom State of Nigeria the young leaves of hibiscus are commonly consumed as vegetable and add into functional foods (Udo, *et al*. 2016) [23]. Hibiscus flowers are highly used after harvesting and one such use is the extract of pigment from flowers. Fresh flowers are used as food coloring and as a component of vegetable salads.
Currently, consumption of different drugs and especially phytochemicals is increasing rapidly worldwide. Since herbal medicines are less harmful than synthetic drugs, they have better compatibility, which improves patient tolerance even on long-term use. Synthetic drugs are associated with uncountable side effects, which are hyperuricemia, diarrhoea, nausea, myositis, gastric irritation, flushing, dry skin, and abnormal liver function.
Hibiscus rosa-sinensis extracts are prevailing in use for ages in Ayurveda to cure many ailments. The plants have the natural health benefit that boasts to cure diseases naturally. World health organization also advocated that traditional medicines have no side effects and can be used safely for treatment of disease. Over 50% of all modern clinical drugs used today have originated from natural products (Udo, *et al.* 2016) [23]. In medicine, the mostly red flowered variety was preferred**.** Flowers were used to cure many health problems like liver disorders, regulation of menstrual cycle, high blood pressure, in stomach pain, for eye problems. Hydroalcoholic flower extracts of *hibiscus rosa-sinensis* contain significant and sustained anti-diabetic activity. *Hibiscus Rosa sinensis* extract has a protective effect on the tumor-promoting stage of cancer development. Pre-treatment with *hibiscus rosa-sinensis* extract partially restored the levels of cellular protective enzymes (Sharma and Sultana, 2004).
In India, hibiscus flowers and leaves are used to treat various diseases and are a part of Indian folk medicine.

In southern India, flower petals are crushed and applied to hair to stimulate hair growth and improve hair blackness. The Khani tribe of Thirunelveli district in the Western Ghats of India believe that the intake of petals of *hibiscus rosa-sinensis* will strengthen the heart. They have also reported that the intake of hibiscus petals in combination with Lawsonia inermis, Bauhinia malabarica and Costus Specios will help improve immunity in children. In a traditional folk medicine system of Sagar taluk in Karnataka, the leaf paste of *hibiscus rasa-sinensis* is mixed with cow's milk and given to women suffering from menstrual disorders. Due to its high flavonoid and terpenoid content, it exhibits significant antioxidant and anticancer activities.

Herbal medicine is the oldest form of healthcare known to mankind. Herbs had been used by all cultures throughout history. As a consequence of reliable experience from the past generations, today, the whole world and all cultures have extensive knowledge about herbal medicines. Plants are a rich source of a widespread variety of secondary metabolites, which are useful in the form of pharmaceuticals, agrochemicals, flavours, fragrances, colours, biopesticides and food additives. *Hibiscus rosa-sinensis* is an edible flower "The edible flower is termed as innocuous and non-toxic flowers with many health benefits included in human diet" (Lu, *et al.* 2016) [18]. Edible flowers have unique and powerful flavour, colour and aroma and therefore have gained popularity in the culinary world as an innovative ingredient (Jadhav, *et al.* 2009). *Hibiscus rosa-sinensis* has innumerous applications. The flowers of this plant are employed to develop a famous beverage in Egypt and are also used to formulate medicines. Different parts of the plant are also added in the development of jams, spices, soups and sauces. In foods and beverages, *hibiscus rosa-sinensis* is mostly used as a taste enhancer. It is additionally used to enhance the odour and appearance in multiple recipes

Procurement

Hibiscus leaves were cleaned and washed under tap water to remove dirt and dust. The washed leaves were spread over plain paper to remove extra water. At that point cut in small pieces and incorporated in products.

Development of powder

Hibiscus rosa-sinensis leaves were cut and air dried at room temperature for 3 to 5 days. The dried hibiscus leaves were grounded in an electric grinder to fine powder. The dried hibiscus powders were kept in air tight containers at room temperature for addition in recipes.

Table 1: Biscuit

Ingredients	Control	I	II	III
Refined flour (g)	100	95	90	85
HR leaves powder (g)	-	5	10	15
Sugar (g)	55	55	55	55
Milk (ml)	20	20	20	20
Ghee (g)	35	35	35	35
Baking powder	3	3	3	3

Method

- Sieved refined wheat flour and hibiscus leaves powder.
- Added sugar, ghee and baking powder and creamed properly.
- Added the flour and hibiscus leaves powder and made dough by using milk.
- Rolled thick and cut into the biscuit shape.
- Baked for 20 minutes at 190 ^{0}C Temperature.

Hibiscus leaves powder biscuit

Control = 100% Refined flour
Sample I = 95% Refined flour + 5% Hibiscus leaves powder
Sample II = 90% Refined flour + 10% Hibiscus leaves powder
Sample III = 85% Refined flour + 15% Hibiscus leaves powder

Biscuit

The sensory characteristics of biscuit prepared by using hibiscus leaves powder, i.e., 5%, 10% and 15% are given in the Table. The sensory properties showed that the biscuit prepared from 100% refined flour, i.e., control was scored 8.00 and rated desirable in respect of texture and taste and scored 7.90 for colour, appearance and 7.95 for overall acceptability and fell in the category of moderately desirable. The result reveals that incorporation of 5% powder was desirable in all attributes. The biscuit prepared by using 10% leaves powder was scored ranging from 8.10-8.20 for different attributes and rated as desirable. Biscuit, prepared by adding 15% leaves powder was moderately desirable in all sensory attributes. Biscuit prepared by 10% addition was better accepted as compared with 5% and 15% added biscuit. Similarly, Srinivasamurthy *et al.* (2017) reported that the incorporation of *moringa oleifera* leaf in *muffin* was acceptable at 12% level. Cookies were prepared by incorporation of moringa oleifera leaf powder at different levels. The 10 and 20% addition of moringa oleifera leaf powder was most acceptable for cookies preparation according to Nwakalor, (2014). Mohd *et al*. (2014) reported that 10% addition of hibiscus powder was most acceptable in development of *muffins*.

Table 2: Mean scores of sensory characteristics of biscuit supplemented with *hibiscus rosa-sinensis* leaves powder

Product	Appearance	Colour	Texture	Taste	Over all acceptability
Biscuit					
Control	7.90±0.23^{ab}	7.90±0.31^{ab}	8.00±0.25^{ab}	8.00±0.25^{a}	7.95±0.19^{b}
Sample I	8.10±0.23^{a}	8.00±0.25^{a}	8.10±0.17^{a}	8.00±0.21^{a}	8.05±0.15^{a}
Sample II	8.20±0.24^{a}	8.10±0.23^{a}	8.20±0.24^{a}	8.10±0.23^{a}	8.15±0.10^{a}
Sample III	7.60±0.22^{c}	7.80±0.13^{b}	7.70±0.15^{c}	7.60±0.22^{b}	7.67±0.13^{c}
CD (p<0.05)	0.29	0.83	0.39	0.44	0.19
Refined Wheat flour control =100%, RWF I=95% HRLP+5%, RWF II=90% HRLP+10%, RWF III=85% HRLP+15%					

Values are mean ± SE of ten panelists

Value with same superscripts in a column do not differ significantly CD (P<0.05)

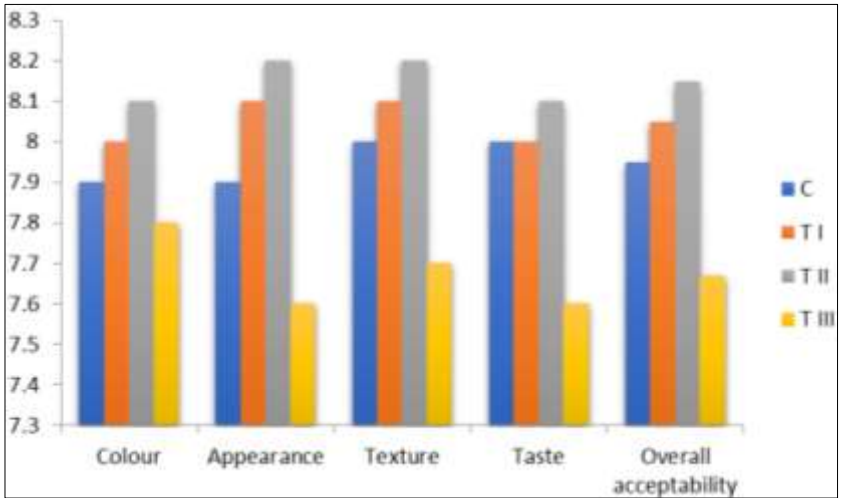

Fig 1: Mean scores of sensory characteristics of biscuit supplemented with *hibiscus rosa-sinensis* leaves powder

Proximate composition

Moisture: There was a non-significant difference in between moisture content of hibiscus leaves powder supplemented and control biscuit.

Fat: There was a remarkable variation in fat content of control and supplemented biscuit. The fat content of control biscuit was 25.18%, which was increased in Sample I (25.29%) and Sample II biscuit (25.43%).

Protein: The protein content in control biscuit was 10.44%, while it was 10.48 and 10.53%, respectively in Sample I and Sample II biscuit.

Fiber: It was seen that the supplemented biscuit was rich in fiber content as compared to control sample. The fiber content was 1.01 and 1.78%, respectively in 5 and 10% Supplemented biscuit, while it was 0.25% in control.

Ash: The increase in ash content of supplemented biscuit was greatly significant as compared to the control biscuit. The Sample I and Sample II biscuit contained 0.96 and 1.51%, respectively ash content whereas, the amount of ash in control biscuit was 0.42%.

Similar outcomes were also noticed by Devi *et al*. (2018) who reported that moisture, fat, fibre and ash content were increased in rhododendron flower powder supplemented biscuit while, protein content was higher in control biscuit. Mohd *et al*. (2014) also observed that moisture, fibre and ash content were higher in muffins which prepared with the addition of hibiscus sabdariffa. L and control muffin had higher content of moisture and protein.

Table 3: Proximate composition of biscuit supplemented with *hibiscus rosa-sinensis* leaves powder (%, dry weight basis)

Samples	Moisture %	Fat %	Protein %	Fibre %	Ash %
Control	2.57±0.03^{a}	25.18±0.01^{b}	10.44±0.01^{a}	0.25±0.01^{c}	0.42±0.01^{c}
Sample I	2.53±0.02^{a}	25.29±0.01^{ab}	10.48±0.03^{ab}	1.01±0.01^{b}	0.96±0.01^{b}
Sample II	2.49±0.02^{a}	25.43±0.01^{a}	10.53±0.02^{b}	1.78±0.02^{a}	1.51±0.02^{a}
CD (p<0.05)	0.20	4.66*	0.01*	4.68*	2.61*

Values are mean ± SE of three estimations; abc different superscripts in the column vary significantly (P<0.05); Control (RWF 100%) Sample-I (RWF: HRLP 95:05) Sample-II (RWF: HRLP 90:10); RWF= Refined Wheat flour HLRP= *Hibiscus rosa-sinensis* Leaves Powder

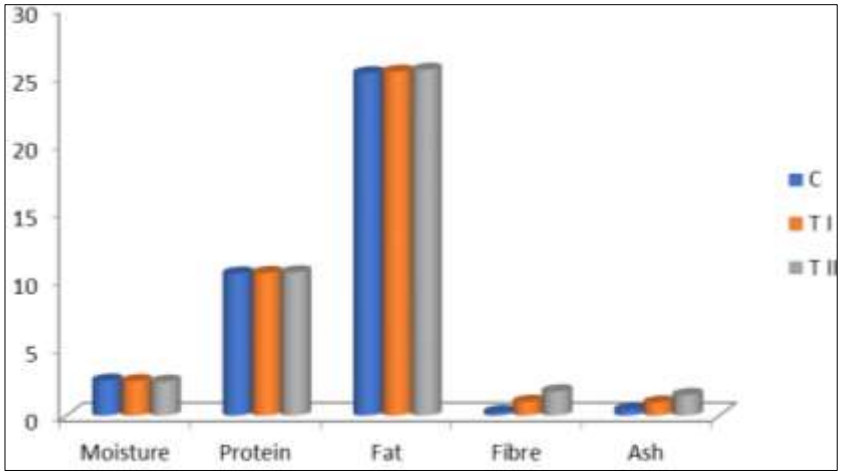

Fig 2: Proximate composition of biscuit supplemented with *hibiscus rosa-sinensis* leaves powder (%, dry weight basis)

Vitamins

A significant (p<0.05) difference was observed in β-carotene content of control biscuit and supplemented biscuit. In control biscuit, β-carotene content was found 53.76 µg/100 g which increased to 130.71 µg/100 g in Sample I and 207.02 µg/100 g in Sample II biscuit. Vitamin C content increased significantly (p<0.05) in hibiscus supplemented biscuit. Maximum vitamin C amount was observed in Sample II *Biscuit* (9.03 mg/100 g) and followed by Sample I biscuit (4.05 mg/100 g). Hibiscus flower powder had great amount of β-carotene and vitamin C Similar result was also observed by Igbabul *et al*. (2018) who reported that vitamins content of moringa leaf supplemented biscuit were higher than control biscuit.

Table 4: Vitamins content of biscuit supplemented with *hibiscus rosa-sinensis* leaves powder (g/100g, dry weight basis)

Samples	Vitamin A (µg)	Vitamin C (mg)
Control	53.76±0.03^{c}	0.09±0.01^{c}
Sample I	130.71 ±0.02^{b}	4.05±0.02^{b}
Sample II	207.62±0.02^{a}	9.03±0.01^{a}
CD (p<0.05)	2.6*	3.46*

Values are mean ± SE of three estimations; abc different superscripts in the column vary significantly (p<0.05); Control (RWF 100%) Sample-I (RWF: HRLP 95:05) Sample-II (RWF: HRLP 90:10); RWF= Refined Wheat flour HRLP= *Hibiscus rosa-sinensis* Leaves Powder

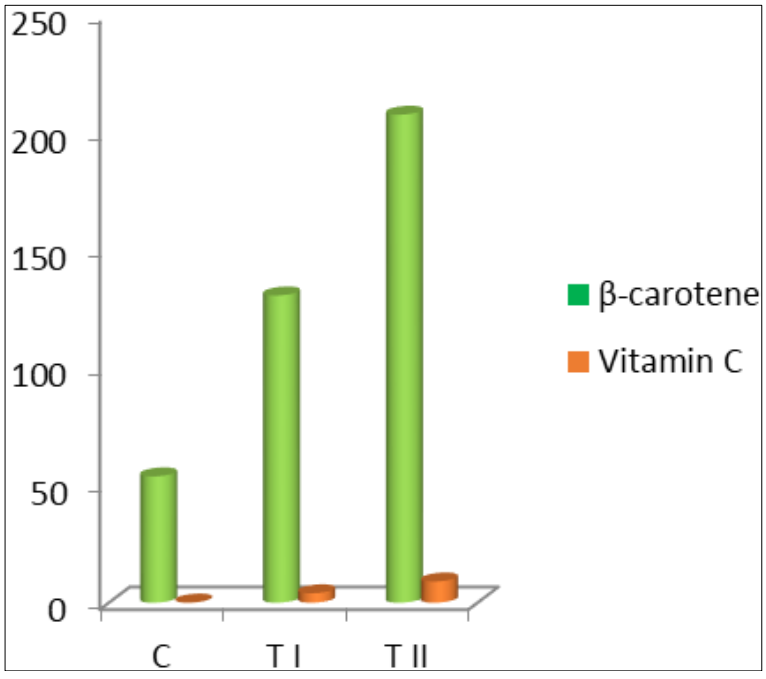

Fig 3: Vitamins content of biscuit supplemented with *hibiscus rosa-sinensis* leaves powder (g/100g, dry weight basis)

Minerals

The control biscuit had 2.75 mg/100g of iron, which increased significantly (p<0.05) in hibiscus supplemented Biscuit. Iron content in Sample I and Sample II biscuit was 3S.26 and 3.78 mg/100 g, respectively. Hibiscus leaves Powder was rich in iron content. The zinc content of control biscuit was differed significantly (p<0.05) from supplemented biscuit. Zinc content of control biscuit was 1.37mg/100g, which was increased in supplemented biscuit. A significant (p<0.05) difference was seen in the biscuit for manganese content. Sample II biscuit had significantly (p<0.05) higher manganese content (0.19 mg/100 g) Followed by Sample I biscuit (0.12mg/100 g) and control biscuit (0.08mg/100g). Calcium content of control, Sample I

and Sample II biscuit was 40.54, 122.07 and 203.49 mg/100 g, respectively. A significant (P<0.05) increase of calcium content in supplemented biscuit was observed as compared to control sample. Srinivasamurthy *et al*. (2017) developed *muffin* incorporated with *Moringa oleifera* leaf. %). Supplemented *Muffin* had iron (3.55mg/100g), calcium (55.06mg/100g), potassium (111.03mg/100g). Gupta *et al*. (2017) [16] determined nutritional properties *uthpam* prepared with addition of kachnar leaves. *Uthpam* had moisture 33.61 g, ash 51.86 g, fat 1.6 g, protein 7.37 g, carbohydrates 63.95 g, iron 2.44 mg and calcium 56.78 mg per 100 g.

Table 5: Minerals content of biscuit supplemented with *hibiscus rosa-sinensis* leaves powder (g/100g, dry weight basis)

Samples	Iron (mg)	Manganese (mg)	Zinc (mg)	Calcium (mg)
Control	2.75±0.02^{c}	0.08±0.01^{b}	1.37±0.01^{c}	40.54±0.02^{c}
Sample I	3.26±0.02^{b}	0.12±0.02^{b}	1.91±0.02^{b}	122.07±0.02^{b}
Sample II	3.78±0.02^{a}	0.19±0.02^{a}	2.45±0.01^{a}	203.49±0.03^{a}
CD (p<0.05)	3.06*	0.03*	4.19*	5.93*

Values are mean ± SE of three estimations; abc different superscripts in the column vary significantly (p<0.05); Control (RWF100%) Sample-I (RWF: HRLP 95:05) Sample-II (RWF: HRLP 90:10); RWF= Refined Wheat flour HRLP= *Hibiscus rosa-sinensis* Leaves Powder

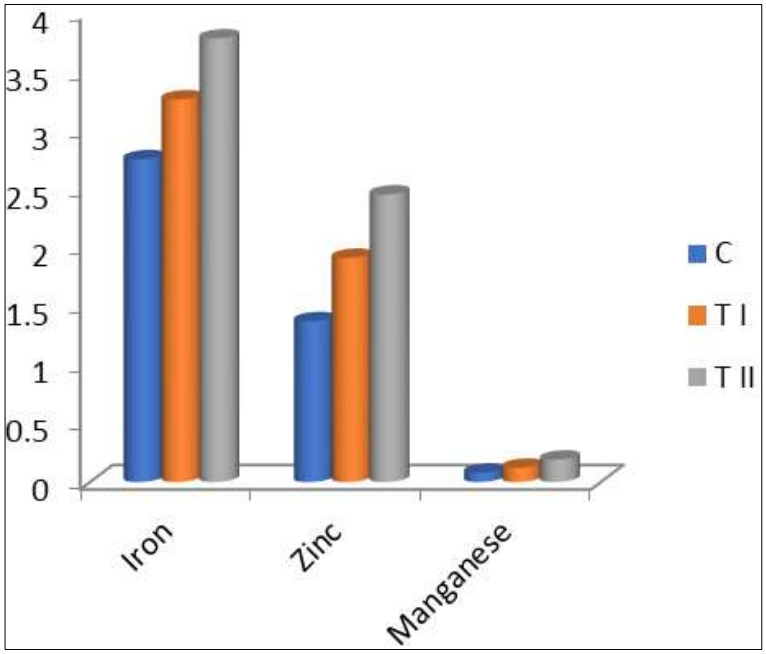

Fig 4: Minerals content of biscuit supplemented with *hibiscus rosa-sinensis* leaves powder (g/100g, dry weight basis)

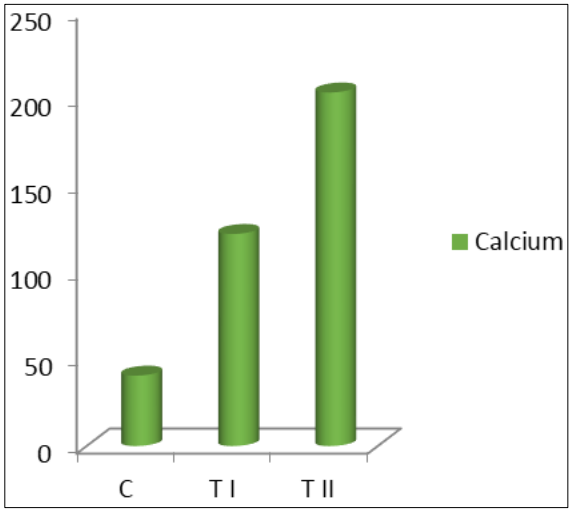

Fig 5: Calcium content of biscuit supplemented with *hibiscus rosa-sinensis* leaves powder (g/100g, dry weight basis**)**

Summary and Conclusion

The biscuit prepared by using hibiscus leaves powder, i.e., 5%, 10% and 15%. The sensory properties showed that the biscuit prepared from 100% refined flour, i.e., control was scored 8.00 and rated desirable in respect of texture and taste and scored 7.90 for colour, appearance and 7.95 for all-inclusive acceptability and fell in the category of moderately desirable. The result reveals that incorporation of 5% powder was desirable in all attributes. The biscuit prepared by using 10% leaves powder was scored ranging from 8.10-8.20 for different attributes and rated as desirable. Biscuit, prepared by adding 15% leaves powder was moderately desirable in all sensory attributes. Biscuit prepared by 10% addition was better accepted as compared with 5% and 15% added biscuit.

Control biscuit had higher moisture and crude protein (2.57 and 10.44%, respectively) while crude fat (25.43%), crude fibre (1.78%) and ash (1.51%) content were higher in Sample II hibiscus leaves based biscuits. Sample II biscuit contained significantly higher amount of β Carotene and vitamin C. Iron (3.78mg/100g), Zinc (2.45mg/100g), Manganese (0.19mg/100g) and calcium (203 mg/100g) content were also significantly higher in Sample II biscuits.

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