

Original Research Article

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Formulation and Evaluation of Fresh Red Hawaiian Hibiscus (*Hibiscus rosa-sinensis*) Incorporated Valued Added Products

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ABSTRACT

Keywords

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Edible flowers impart unique and powerful color, aroma and flavor to the food. They are rich in nutrients, and also possess antioxidant and antimicrobial properties. *Hibiscus rosa-sinensis* is an evergreen shrub, belonging to the *Malvaceae* family. The present investigation was aimed to enhance the consumption of Hibiscus as an edible flower in the daily diet in order to exploit their nutritional benefits. The nutritional composition of fresh red *Hibiscus rosa-sinensis* flowers was analyzed and these flowers were incorporated into various products. Fresh *Hibiscus rosa-sinensis* flowers had 1.54 g protein and 0.35 g fat. Total ash was 1.40 g / 100 g, crude fibre was 1.50 g and carbohydrate was 13.71 g per 100 g. Among vitamins the flowers had β -carotene (54.02 μ g) and vitamin C (7.502 mg). Three different variations of the gulkand and juice were prepared and were subjected to acceptability studies. The macronutrient composition was computed and shelf life study was carried out. Gulkand with 10 per cent variation and juice with 50 per cent variation was found to be most acceptable. Gulkand was found to be suitable for consumption after 60 days of storage.

Introduction

Edible flowers have been traditionally utilized for human consumption in various cultures. They enhance the taste, appearance and aesthetic value of food. "The edible flower is defined as Non-toxic, innocuous flowers with health benefits consumed in human diet" (Lu *et al.*, 2016). There is a wide range of underutilized edible flower species which have the potential for nutritional and commercial exploitation in varied forms.

Hibiscus rosa-sinensis is commonly known as Hawaiian hibiscus or Chinese hibiscus. It is cultivated throughout India and has several forms with varying colors and flowers. All the parts of *Hibiscus rosa-sinensis* and their respective chemical constituents are used for their antiovolutory, anti-tumor, spasmolytic, antifertility, antipyretic, hypoglycaemic, anti-inflammatory, analgesic, antimicrobial, CNS depressant, and hypotensive activity (Jadhav *et al.*, 2009).

Value addition to food products has assumed vital importance in recent days. Value is added to the food products in order to enhance their palatability and/or nutritional value or to increase the shelf life of perishables by altering or modifying their form, color, manufacturing process and other attributes. Thus, the present investigation is an attempt to analyze the nutritional composition of fresh red Hawaiian hibiscus flowers, formulate value added products from the flowers and study their shelf life.

Materials and Methods

The raw material required for the study was procured from home gardens of farmers of Doddaballapura taluk of Bengaluru. The sepals were manually separated, the petals and stalk were washed in tap water to remove extraneous matter and finely chopped using stainless steel knife. The fresh flowers were subjected to nutrient analysis. Moisture, protein, fat, crude fiber, ash, potassium, iron and zinc were estimated following AOAC standard methods (1980). Calcium content was determined by titrating it against 0.01 N EDTA as described by Heau *et al.* (1965). The vitamin C concentration was determined using redox titration with potassium iodate in the presence of potassium iodide (Tauber and Kleiner, 1935). The concentration of β -carotene was measured in spectrophotometer at 450 nm (Ranganna, 2002). Antioxidant capacity was estimated by DPPH (2, 2-diphenyl-1-picrylhydrazyl) radical scavenging activity method (Kang and Saltveit, 2002). Gulkand and juice were prepared by incorporating fresh hibiscus flower petals. Nutrient composition of the best accepted developed products was computed based on the nutritional composition of the ingredients (Gopalan *et al.*, 2014). Shelf life study was done for the products based on sensory scores, moisture content and microbial analysis.

Results and Discussion

Nutritional analysis of fresh flowers

The results of the nutritional analysis of fresh red Hawaiian hibiscus flowers are shown in Table 1. It was found that fresh *Hibiscus rosa-sinensis* flowers had 83.00 per cent moisture, 1.54 g protein and 0.35 g fat. Total ash was 1.40 g / 100 g, crude fibre was 1.50 g and carbohydrate was 13.71 g per 100 g. Among vitamins the flowers had β -carotene (54.02 μ g) and vitamin C (7.502 mg). The results of mineral analysis showed that fresh flowers had 4.32 mg of calcium, 236.45 mg potassium, 1.48 mg of iron and 0.82 mg zinc. These results are comparable with the findings of Jadhav *et al.* (2009) who reported that the edible part of fresh *Hibiscus rosa-sinensis* flower contains 89.80 g of moisture, 0.064 g of nitrogen, 0.36 g of fat, 1.56 g of crude fibre, 4.04 mg of calcium, 26.68 mg of phosphorus, and 1.69 mg of iron, 4.90 mg ascorbic acid per 100 g of flowers.

Total antioxidant activity was found to be 60.12 mg ascorbic acid equivalents/100g. Khan *et al.* (2014) reported the total antioxidants in methanol and ethanol extract of *Hibiscus rosa-sinensis* which showed total phenolics 61.45 \pm 3.23 and 59.31 \pm 4.31 mg/100g as gallic acid equivalent, total flavonoids 53.28 \pm 1.93 and 32.25 \pm 1.21 mg/100g as catechine equivalent, DPPH free radical scavenging activity 75.46 \pm 4.67 and 64.98 \pm 2.11 per cent respectively.

Formulation of value added products

Value added products *viz.*, gulkand, and juice were prepared from hibiscus flowers. Sensory evaluation was carried out for acceptance of the products using nine point hedonic scale by 21 semi-trained panel members. Table 2 enlists the formulation of the developed value added products from fresh hibiscus flowers.

Traditionally gulkand has been used as a cooling tonic to combat fatigue, lathery, muscular aches, biliousness itching, and heat-related conditions. It is good for memory and eyesight as well as a good blood purifier. Gulkand also helps reducing hyperacidity. It is also rich in calcium and has antioxidant properties (Pendawale *et al.*, 2015). The rose flowers were substituted with hibiscus flowers in order to improve the antioxidant and nutritional quality as well as to reduce the cost of the product as rose petals are a costly ingredient.

Gulkand with 10 per cent hibiscus flowers was best accepted with highest scores of 8.19, 8.19, 8.04, 7.90, 8.19 and 7.90 for appearance, colour, aroma, taste and overall acceptability respectively. Control scored 8.42, 8.42, 8.33, 8.33, 8.14 and 8.15 for appearance, colour, aroma, texture, taste and overall acceptability respectively.

Juice prepared with 50 per cent hibiscus was best accepted with highest scores of 8.57, 8.57, 8.76, 8.23, 8.66 and 8.76 for appearance, colour, aroma, consistency, taste and overall acceptability respectively. Control prepared with 70 per cent pineapple scored 8.57, 8.61, 8.28, 8.19, 8.28 and 8.19 for appearance, colour, aroma, consistency, taste and overall acceptability respectively.

Macronutrient composition of best accepted products

The macronutrient composition of the best accepted and control products were computed and the results are displayed in Table 3. In gulkand there was not much difference in the macronutrient composition between HGL1 and control which is probably due to the similar macronutrient composition of rose and hibiscus flowers. However, the ash content reduced from 0.99 g to 0.24 g in HGL1 compared to control.

Shelf life study of the developed products

Gulkand was packed in glass jars and kept at room temperature. Sensory attributes, moisture content and microbial population were observed at an interval of 30 days i.e. initial, 30th and 60th day for chocolates and gulkand. Shelf life study for juice was not conducted as it is meant to be consumed fresh.

The results of the mean sensory score evaluation of gulkand from initial day to 60 days of storage study period are presented in the Table 4. Decrease in the sensory score was observed during storage period. The control sample showed scores of 8.04, 8.00, 7.95, 7.95, 7.76 and 7.71 for appearance, colour, texture, aroma, taste and overall acceptability respectively, whereas the HGL1 (10 per cent) variation had mean sensory scores of 8.00 (appearance), 7.61 (texture), 7.90 (colour), 7.76 (aroma), 7.90 (taste) and 7.66 (overall acceptability) after 60 days of storage studies. Control was more acceptable after storage than variation HGL1. It was evident from the sensory scores that, even after 60 days of storage period both the products *viz.*, control and HGL1 were acceptable. There was a decline in the sensory score of colour and appearance for both the samples as the fresh product samples had a bright red color, because of more anthocyanins which may have gradually decreased on storage leading to colour fading and less attractive colour and appearance. Anthocyanins are said to turn into brown pigment as a result of decomposition.

These results were in accordance with general findings that monomeric pigment concentrations decrease during storage (Withy *et al.*, 1993). Similar results of decrease in sensory scores were reported for strawberry jam by Kimura *et al.*, (1994) where room temperature storage resulted in

rapid deterioration including off-flavor, discoloration, browning.

This deterioration in flavour may be attributed to the decomposition of sucrose in gulkand caused by organic acids and enzymes. Similar results on the effect of storage time and temperature (5°C) on apricot jams were reported by Touati *et al.* (2014) where the scores for taste reduced from 7.56 on day 0 to 7.00 after 60 days of storage.

Microbial population (bacteria, moulds and coliforms) of control and best accepted variations of developed products was estimated using standard plate count method on initial, 30th and 60th days and are depicted in Table 5 and Figure 1. The total bacterial population on 60th day was 3.60×10^2 cfu/g and 2.93×10^2 cfu/g for control and HGL1 respectively. The mould population was 0.06×10^2 cfu/g for control on initial day which

was increased to 1.33×10^2 cfu/g during 60 days of storage. For HGL1, the mould population was 0.13×10^2 cfu/g on initial day and 1.16×10^2 cfu/g on day 60. *Escherichia coli* was absent in control on initial day and grew to 0.53×10^2 cfu/g during the storage period of 60 days. In HGL1 samples, *Escherichia coli* population increased from 0.13×10^2 cfu/g to 0.50×10^2 cfu/g during 60 days of storage.

As number of days of storage increased there was an increase in microbial growth. High water availability and sugar content may be the factors responsible for the increase in the microbial population. As per results, gulkand was fit for consumption up to 60 days. Similar results were reported by Sindumathi and Amutha (2014) where an increasing trend in bacterial and fungal population was observed in stored coconut based jam throughout the storage period.

Table.1 Nutritional composition of fresh red *Hibiscus rosa-sinensis* flowers

Nutrient	Fresh <i>Hibiscus rosa-sinensis</i> flowers (per 100g fresh weight)
Moisture (%)	83.00
Protein (g)	1.54
Fat (g)	0.35
Total ash (g)	1.40
Crude fibre (g)	1.50
Vitamins	
β-carotene (µg)	54.02
Vitamin C (mg)	7.50
Minerals	
Calcium (mg)	4.32
Potassium (mg)	236.45
Iron (mg)	1.48
Zinc (mg)	0.82
Total antioxidant capacity (mg AAE/100g)	60.12

Table.2 Development of value added products

Name of the product	Ingredients used	% Level of incorporation of hibiscus flowers
Gulkand	Rose petals, sugar, honey	10, 25 and 50
Juice	Pineapple juice, sugar, citric acid	10, 25 and 50

Table.3 Macro nutrient composition of developed products (per 100g/ml)

Products		Moisture (%)	Protein (g)	Fat (g)	Total ash (g)	Crude fibre (g)	Carbohydrate (g)	Energy (Kcal)
Gulkand	Control	41.71	0.97	0.32	0.99	0.82	55.69	228.46
	HGL1	41.91	0.94	0.28	0.24	0.80	55.66	227.86
Juice	Control	89.20	0.80	0.48	0.16	0.34	7.80	38.72
	HJC3	90.40	0.56	0.23	0.13	0.26	6.90	31.91

HGL1- Hibiscus gulkand 1 (10%), HJC3- Hibiscus juice 3 (50%)

Table.4 Mean sensory score for shelf life of hibiscus gulkand

Products	Duration	Appearance	Color	Texture	Aroma	Taste	Overall acceptability
Control	Initial	8.42	8.42	8.33	8.33	8.14	8.14
	30th day	8.23	8.23	8.14	8.28	7.95	7.95
	60th day	8.04	8.00	7.95	7.95	7.76	7.71
	F value	NS	NS	NS	NS	NS	NS
	SEm±	0.16	0.16	0.20	0.16	0.22	0.21
	CD at 5%	-	-	-	-	-	-
HGL 1 (10%)	Initial	8.19	8.19	7.90	8.04	8.19	7.90
	30th day	8.19	8.09	7.76	7.85	8.04	7.80
	60th day	8.00	7.90	7.61	7.76	7.90	7.66
	F value	NS	NS	NS	NS	NS	NS
	SEm±	0.17	0.17	0.17	0.17	0.16	0.16
	CD at 5%	-	-	-	-	-	-

*Significant at 5% level, NS- Non significant, HGL 1- Hibiscus gulkand 1

Table.5 Population of bacteria, moulds, and coliforms in hibiscus gulkand

Products	Duration (Days)	Population of microorganisms ($\times 10^2$ cfu/g)		
		Bacteria	Moulds	Coliforms
Control	Initial	0.16	0.06	Nil
	30 th day	2.43	0.90	0.36
	60 th day	3.60	1.33	0.53
	F value	*	*	*
	SEm \pm	3.86	1.24	0.38
	CD at 5%	13.64	4.40	1.35
HGL1 (10%)	Initial	0.20	0.13	0.13
	30 th day	2.13	0.73	0.36
	60 th day	2.93	1.16	0.50
	F value	*	*	*
	SEm \pm	3.39	1.31	0.57
	CD at 5%	11.97	4.565	2.03

*Significant at 5% level, NS- Non significant, HGL1- Hibiscus gulkand 1

Table.6 Mean moisture content for shelf life study of hibiscus gulkand

Products	Duration	Moisture content (%)
Control	Initial	41.71
	30 th day	40.13
	60 th day	38.32
	F value	*
	SEm \pm	0.21
	CD at 5%	0.75
HGL1 (10%)	Initial	41.91
	30 th day	40.24
	60 th day	39.66
	F value	*
	SEm \pm	0.26
	CD at 5%	0.91

*Significant at 5% level, NS- Non significant, HGL1- Hibiscus gulkand 1

Fig.1 Microbial population of hibiscus gulkand (HGL1 10%) on storage (per g)

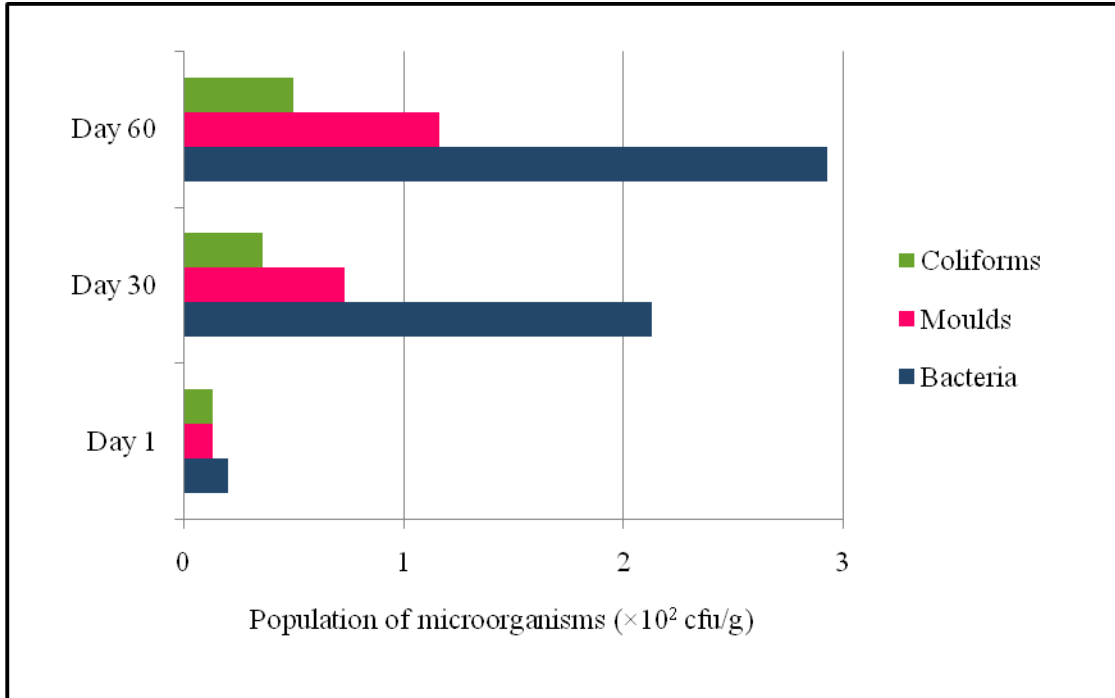
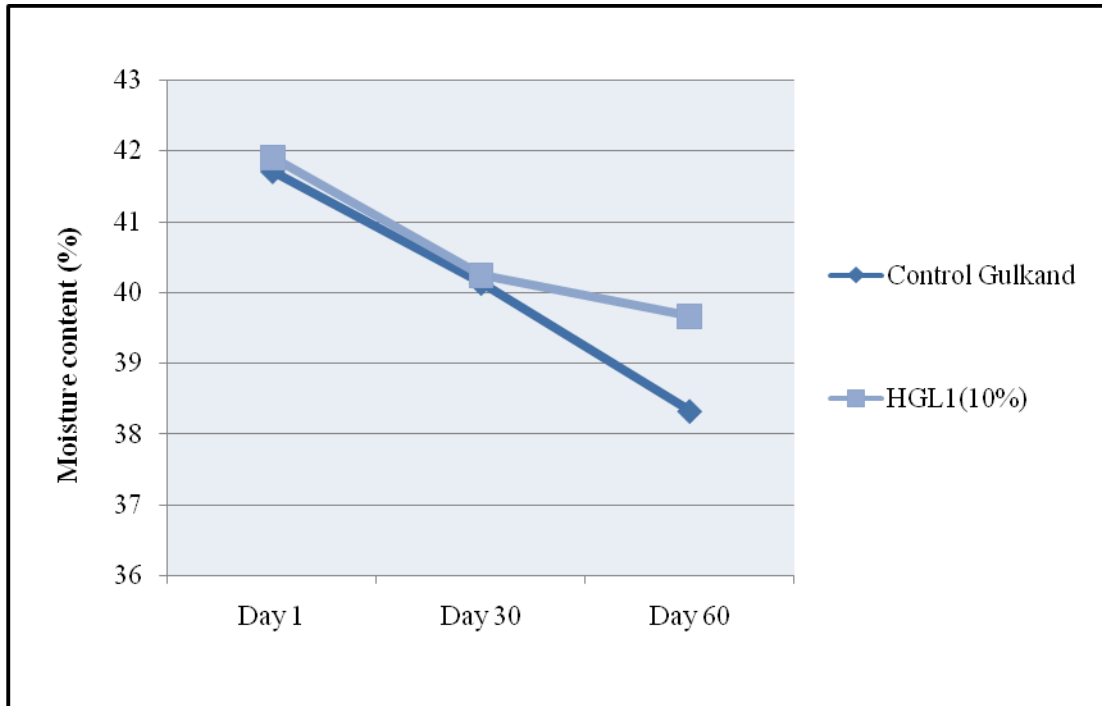


Fig.2 Mean moisture content of control and hibiscus gulkand during storage



Comparing with HGL1, the control samples had higher population of microbes indicating that the microbial growth was more rapid in

the control samples. Polyphenols, flavonoids and tannins present in HGL1 might be responsible for the observed antibacterial

activity. These compounds are generally produced by plants as a mode of defense against microbial infections (Mak *et al.*, 2013).

The changes in moisture content during storage are depicted in Table 6 and Figure 2. The moisture content of both control and HGL1 gulkand decreased significantly during the 60 days storage period. The moisture content of control gulkand decreased from 41.71 on day 1 to 40.13 on day 30 and finally to 38.32 on 60th day of storage. For HGL1 the moisture content was 41.91 initially, 40.24 on 30th day and 39.66 on 60th day of storage. The decrease in moisture content may be due to loss of moisture due to higher moisture content in the product compared to the storage environment creating a moisture gradient.

The study showed that hibiscus flowers are rich in phytochemicals. Acceptable value added products can be developed from hibiscus to enhance nutritional value and enrich therapeutic benefits. Thus, with further modification, hibiscus flowers can very well be exploited for value addition and consumption.

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