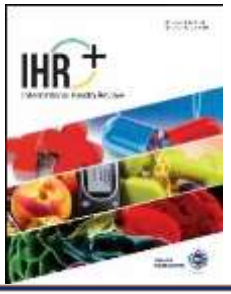

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Sadia Rafiq

Article: **Development of chapattis with the whole wheat flour and fig leaves for type II diabetic patients**

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Development of Chapattis with the Whole Wheat Flour and Fig Leaves for Type II Diabetic Patients

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Abstract

Diabetes is becoming the major cause of morbidity and mortality throughout the world. Its prevalence throughout the Pakistan population is 11.77%. Medicinal plants and herbs are being used since the ancient times to treat diabetes. One of these plants is fig and its several species are being used for maintaining the blood glucose level. It contains many bioactive compounds such as flavonoids, tannins, vitamin E, sterols, and alkaloids etc. which play important role in regulating blood glucose levels. In the following study, chapattis were developed by fortifying whole wheat flour with fig leaves to check its effectiveness in lowering blood glucose level. Sensory evaluation and proximate analysis of the product was done along with the two different compositions used for the product development. Two biochemical tests – fasting blood glucose level and 2-h postprandial blood glucose level were performed on diabetic patients. The obtained data was subjected to appropriate statistical techniques. The results showed that the chapattis with 15 gm of fig leaves were the most appropriate to consume because chapattis with 10 gm of fig leaves were effective but in the long run whereas chapattis with 20 gm of fig leaves had the tendency to put an individual in hypoglycaemic state.

Keywords: Whole wheat flour, Diabetes, Fig Leaves, Medicinal plants, Flavonoids

Introduction

Diabetes is known to be the world's largest endocrine disorder with the highest rate of resulting in morbidity and mortality. The long term complications associated with it are retinopathy, nephropathy, neuropathy and angiopathy. Medicinal plants are being used worldwide to cure or prevent diseases. Out of all the species of genus ficus, only six species are

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being used for the medicinal purposes. This plant has various effects on the body such as anti-inflammatory, anti-carcinogenic, anti-microbial [1, 2].

The growth of disease prevalence among under developed countries peruse with the fashion of modernization and with the adoption of such way of living which changes the dietary habit towards westernized diet. This shows that the cure of diabetes lies in the change of lifestyle, where change in dietary therapy and nutrition plan depicts a significant milestone for treatment of diabetics [3].

Amongst different types of treatments for DM, diet is of critical importance. Foods of medicinal value have been verified effectual and thus are extensively utilized as they merge two basic cardinal factors: food and medication [4].

It affects all age groups and both the genders males and females. The prevalence of this metabolic disorder is higher in urban areas than that of rural areas and males are more affected by it than females. Overall prevalence of diabetes in Pakistan is 11.77% and throughout the world its prevalence in adults is 8.5% (WHO, 2016) [5].

The prevalence of type 2 diabetes has been increased from the previous times throughout the Pakistan. Comprehensive strategies are required to overcome the increasing incidences of this disease by developing and incorporating prevention, screening and treatment for the diabetes [6].

The scope of functional food has grown steadily over the past two decades; functional foods have possible benefits to improve wellbeing and minimize the likelihood of chronic diseases outside the essential nutritional roles, and thus much focus has been paid. In recent years, researchers have centered on the actions of functional food bioactive compounds in the regulation of different facets of diabetes mellitus; in vitro and in vivo, some beneficial effects of these substances and sources of food have been studied, and some clinical studies have also verified these benefits in patients with diabetes.

Ficus Carica is abundantly used and referred as “Fig”. It is one of the five plants mentioned in Holy Quran along with dates, pomegranate, grapes and Olives. Fig tree (ficus carica) belongs to mulberry family called Moraceae and is found abundantly in tropical as well as subtropical nations [7].

Every part of this plant is being used for the medicinal purposes. It has low acid and high sugar content hence giving a rich flavour. Other than that it

has beneficial minerals and vitamins such as calcium, iron, vitamin C and vitamin A. Fig leaves are also rich in psitaraxasteryl ester, coumains, sapogenin, quercetin, and rutin. The fig leaves are considered to have anti-inflammatory, antioxidant, laxative effect. They are also used to treat diabetes, painful conjunctivitis and asthma.

The decoctions of ficus carica in the form of ethyl acetate extract were used for their effect on blood glucose level and lipid levels in wistar rats with induced type 2 diabetes. After 28 days of administration of this extract the results showed improvement in glucose uptake by the body and it also lowered the lipid levels of the rats [8].

Abscisic acid standardized fig extracts can lower the blood glucose level by 25% and 24% when administered in adults by 4 different levels. The levels that showed significant reduction in glucose level were 200 and 1200 mg extract. The other two lower doses affected the lowering of blood glucose level by 14% only [9]. However, the results could not reach the significant statistics but these extractions can be used as supplements for reducing the blood glucose levels in pre-diabetics as well as in patients with type 2 diabetes.

The suppression of hepatic gluconeogenesis was observed after administering the ficuscarica extract in diabetic mice. It was found that the extract inhibited the process of gluconeogenesis by activating AMPK transcription factor and down regulated the gluconeogenic enzymes [10].

Plants have been considered the most important part of human diet as they are rich in secondary metabolites, bioactive components such as phytochemicals, antioxidants and phytosterols etc. Plant extracts are being widely used for the prevention or cure of certain diseases. Figs are of main concern when it comes to the prevention of diseases because of its richness in bioactive components. Fruit, peel and leaves were studied for their hypoglycaemic effect and among them leaves showed the higher effect in lowering blood glucose levels [11].

Wheat germ consumption was studied for its effect in lowering blood glucose and blood lipid levels. One group was given 20 gm of wheat germ while other was the control group. The group which was given wheat germ showed the reduction in total cholesterol level but did not have significant impact on the blood glucose level, blood pressure and triglyceride. As the

results were not significant statistically but had other health effects if it is to be used for public at larger scale [12].

Whole grain bread with three different types of processing techniques was used to observe the impact of grains in the body according to their size. Among them stone-ground flour showed the significant decrease in postprandial glycemia. This showed that the structural integrity of grains is important and decides the glycemic increase in the body hence is required for the dietary recommendation that in which form grains should be consumed [13].

Objectives

The objectives of the study were:

- To develop the chapattis with whole wheat flour fortified with fig leaves
- To analyse the proximate profile of the chapattis and the flour compositions used for the product development
- To determine the therapeutic potential of chapattis against type II diabetes in patients

Methodology

The study was conducted to find out the hypoglycaemic activity of the chapattis made with whole wheat flour and fig leaves and consumed by diabetic patients.

Procurement of Raw Material

The current study was conducted in the institute of Home Sciences, University of Agriculture Faisalabad and further analysis was done in postgraduate laboratory at National Institute of Food Sciences and Technology. Whole wheat flour and Fig leaves were collected from the local market of Faisalabad to develop the product for the diabetic patients.

Product Development

In the product development phase, the whole wheat chapattis were prepared in the compositions mentioned in the treatment plan. Stems and branches were stripped off and the leaves were washed with the clean water and dried under the shade for three days after drying the leaves were pulverised and sieved. The different compositions of products were subjected to the proximate analysis to find out the moisture, crude fat, crude fibre, crude

protein and mineral content by following the AOAC (2016) [14] standard method.

Steps to Make Product

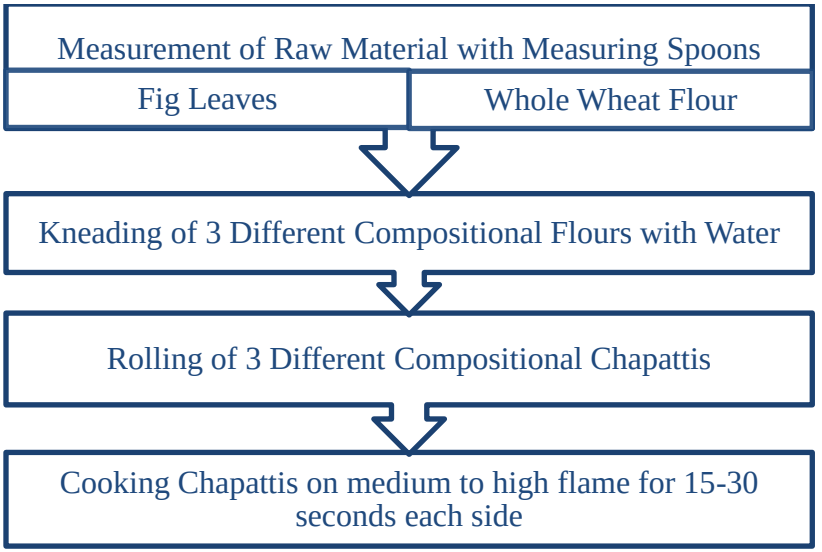

Figure 1. Flow chart of product development

Standardized Recipe

The United States Department of Agriculture (USDA) defines a standardized recipe as one "that has been tried, adapted and retired several times for use by a given foodservice operation and has been found to produce the same good results and yield every time when the exact procedures are used with the same type of equipment and same quantity and quality of ingredients".

Experimental Group 1

The first composition for chapatti was 90 gm whole wheat flour with 10 gm of dried fig leaves powder which were measured with the help of measuring spoons. Dough was prepared by mixing whole wheat flour and dried leaves with the water as required. Each side of the chapatti was cooked for 15-30 sec. It made the standard sized chapatti of 6 inches. After that the chapatti was placed in a container to be evaluated by expert panellist in Institute of Home Sciences.

Experimental Group 2

The second composition for chapatti was 85 gm whole wheat flour with 15 gm of dried fig leaves powder which were measured with the help of measuring spoons. It was kneaded with the water as required. Each side of the chapatti was cooked for 15-30 seconds. It made the standard sized chapatti of 6 inches. After that the chapatti was placed in a container to be evaluated by expert panellist in Institute of Home Sciences.

Experimental Group 3

The third composition for chapatti was 80 gm whole wheat flour with 20 gm of dried fig leaves powder which were measured with the help of measuring spoons. It was kneaded with the water as required. Each side of the chapatti was cooked for 15-30 seconds. It made the standard sized chapatti of 6 inches. After that the chapatti was placed in a container to be evaluated by expert panellist in Institute of Home Sciences.

Sensory Evaluation

Chapattis with fig leaves fortification were evaluated with the sensory evaluation of the product for taste, texture, flavour and overall acceptability. Sensory evaluation was done by the expert panel using a 9-point hedonic scale to find out the most acceptable composition of the product [15].

Proximate Analysis

The chapattis made with composite flour were analyzed for nutritional composition. Proximate analysis was done to determine the moisture content, NFE (nitrogen free extract), crude fat, crude protein and crude fibre according to their corresponding method (AOAC, 2006) [16]. Proximate analysis was performed in the lab of institute of Home Sciences, UAF. Powder of chapattis with three different fig leaves content was procured to conduct the proximate analysis. Moisture content was determined following standards of AOAC (2007) [17] by using oven drying. Crude ash of chapattis was determined by using the standard method No.08-01 described in AOAC (2007). The protein content of the chapattis was determined through the Kjeldahl's procedure as demonstrated by AOAC (2007) Method No.46-10. The nitrogenous contents of sample were turned into ammonium sulphate as result of sulphuric acid (H_2SO_4) digested in the presence of digestion mixture and decomposed by 40% sodium hydroxide (NaOH). Ammonia was collected in a standard boric acid solution and titrated against N/10 H_2SO_4 then the nitrogenous contents of sample was calculated and this nitrogenous content was then converted into crude

protein by multiplying it with 6.25. Crude fat of chapattis sample was determined through the Soxhlet apparatus as described by AOAC (2007) Method No.30-25. 5 g of dried and ground chapattis were wrapped in a filter paper and shifted in the thimble then put in to the extraction tube. For crude fiber estimation, dried and free of fat sample was first digested with 1.25% solution of H_2SO_4 for about 30 min and then with NaOH (1.25% solution) as described by AOAC (2006) in Method No. 978-10. Lastly, NFE (Nitrogen free extract) was calculated using the following equation:

% NFE= (100- % Crude ash + % Crude protein + % Moisture + % Crude fiber + % Crude fat)

Bioactive Component Analysis

For bioactive component analysis total phenol content and total flavonoid content were analyzed using standard procedures described by Hasan *et al*., (2015) and Chang *et al*., (2006) [18, 19] respectively. The calibration curve for each sample was plotted based on the concentration related absorbance. The results for total phenol content were expressed as Gallic acid equivalent while for the total flavonoid content it was expressed as catechins equivalent

Test Subjects

A sample of 20 Type II diabetes mellitus patients were selected randomly from Faisalabad for the interventional study. The sample was divided in 4 groups. Each group was consisting of 5 type II diabetic patients. Experimental group 1, experimental group 2, Experimental group 3 consumed the wheat and fig leaves chapattis for 90 days.

Treatment Plan

Table 1. Treatment Plan of Experimental Groups and Control Group

Treatment	Whole Wheat Flour (gm)	Dried Fig Leaves (gm)
Control Group	100 gm	0 gm
Experimental Group 1	90 gm	10 gm
Experimental Group 2	85 gm	15 gm
Experimental Group 3	80 gm	20 gm

The table 1 shows the treatment plan for all groups for 21 days. The control group consumed 100 gm of whole wheat flour chapatti for 21 days. Experimental group 1 subjects consumed chapatti made with 90 gm whole wheat flour and 10 gm dried fig powder, experimental group 2 subjects

consumed chapatti made with 85 gm whole wheat flour and 15 gm dried fig powder and experimental group 3 subjects consumed chapatti made with 80 gm whole wheat flour and 20 gm dried fig powder**.**

Biochemical Tests

Fasting Blood Plasma Glucose Level

This test was performed once a day throughout the study duration.

2-hr Postprandial Blood Glucose Level

This test was performed after 2 hs of the product consumption (American Diabetes Association, 2016).

Statistical Analysis

Data was presented as mean ± standard deviation. Data was statistically analyzed using SPSS (Version22.0 software, Chicago, IL, USA). One - way ANOVA and Pearson correlation coefficient. The level of statistical significance was set at $p < 0.05$.

Results and Discussion

Proximate Analysis of Raw material

Whole wheat Chapatti with three different dosage of fig leaves was used to observe the hypoglycaemic effect on human health. The results of each parameter are discussed below:

Table 2. Percentages of Proximate Analysis of Raw Material

	Moisture	**Ash**	**Protein**	**Fat**	**Fiber**	**NFE⁎**
Fig Leaves	67.6 %	5.3 %	4.3 %	1.7 %	4.7 %	16.4 %
Whole Wheat Flour	9.02 %	0.82 %	11.23 %	0.99 %	2.34 %	74.91 %

⁎ Nitrogen Free Extract

Table 2 shows the percentage values of proximate analysis of raw material. In fig leaves there was 67.6 % moisture content, 5.3 % ash, 4.3 % protein, 1.7 % fat, 4.7 % fiber and NFE was estimated 16.4 %. In whole wheat flour 9.02 % was moisture, 0.82 % ash, 11.23 % protein, 0.99 % fat, 2.34 % fiber and 74.91 % NFE. Moisture, ash, protein, fat, fiber and nitrogen free extract values were determined using standard methods of AOAC.

Proximate Analysis of Chapattis (Whole Wheat & Fig Leaves)

Proximate Composition of Group 1 (10 gm fig leaves)

Table 3. Parentages of Proximate Composition of Sample Prepared with 10 Gm Fig Leaves

Composition	Percentage
Moisture	34.37 %
Ash	20 %
Protein	5 %
Fat	3.6 %
Fiber	4 %
NFE	33.03 %

Table 3 shows the percentages of proximate composition of experimental group 1. In experimental groups 1 there was 100 gm whole wheat flour and 10 gm of fig leaves powder used to make chapattis. The tables show that the group1 sample contained 34.37 % moisture, 20 % ash, 5 % protein, 3.6 % fat, 4 % fiber and 33.03 % nitrogen free extract. The total ash, protein, fat, fiber and NFE contents were determined through the method of association of official analytical chemists (AOAC, 2000).

Proximate Composition of Group 2 (15 gm fig leaves)

Table 4. Percentages of Proximate Composition of Sample Prepared with 15 Gm Fig Leaves

Composition	Percentage
Moisture	35.67 %
Ash	3.67 %
Protein	4.9 %
Fat	4.2 %
Fiber	6 %
NFE	44.56 %

Table 4 shows the percentages of proximate composition of experimental group 2 (15 gm Fig Leaves). In experimental groups 2 there 100 gm whole wheat flour and 15 gm of fig leaves powder used to make chapattis. The tables show that the group 2 sample contained 35.67 % moisture, 3.67 % ash, 4.9 % protein, 4.2 % fat, 6 % fiber and 44.56 % nitrogen free extract. The total ash, protein, fat, fiber and NFE contents were determined through the method of association of official analytical chemists (AOAC, 2000).

Proximate analysis of Group 3 (20 gm fig leaves)

Table 5. Percentages of Proximate Composition of Sample Prepared with 20 Gm Fig Leaves

Composition	Percentages
Moisture	35 %
Ash	4 %
Protein	6.8 %
Fat	7.6 %
Fiber	8.5 %
NFE	38.1 %

Table 5 shows the percentages of proximate composition of experimental group 3 (20 gm Fig Leaves). In experimental groups 3 there 100 gm whole wheat flour and 20 gm of fig leaves powder used to make chapattis. The tables show that the group 3 sample contained 35 % moisture, 4 % ash, 6.8 % protein, 7.6 % fat, 8.5 % fiber and 38.1 % nitrogen free extract. The total ash, protein, fat, fiber and NFE contents were determined through the method of association of official analytical chemists (AOAC, 2000) [20], explored the proximate analysis of ficus carica it contains moisture, 67.6%; protein, 4.3%; fat, 1.7%; crude fiber, 4.7%; ash, 5.3%; N-free extract, 16.4%; pentosans, 3.6%; carotene, bergaptene, stigmasterol, sitosterol, and tyrosine.

Total Phenolic Content

Table 6. TPC and Flavonoid Contents in Prepared Samples

	Group 1	Group 2	Group 3
TPC mg/100g	301.4	369.4	462.8
Flavonoids mg/100g	126.9	103.5	130.9

Table 6 shows the average of TPC and flavonoid content in the three samples of chapattis. Highest value of TPC was found in group 3 sample which is 462.8 mg/100g. The total phenols content of whole wheat and fig leaves reported [21] was 0.50% (500mg/100g). Highest value for flavonoid was found to be in group 3 sample which is 130.9 mg/100g. The flavonoid content of whole wheat chapatti and fig leaves obtained by Braid *et al.*, (2012) was 0.36% (360mg/100g) which is in the support of resulted value.

Efficacy of Developed Product

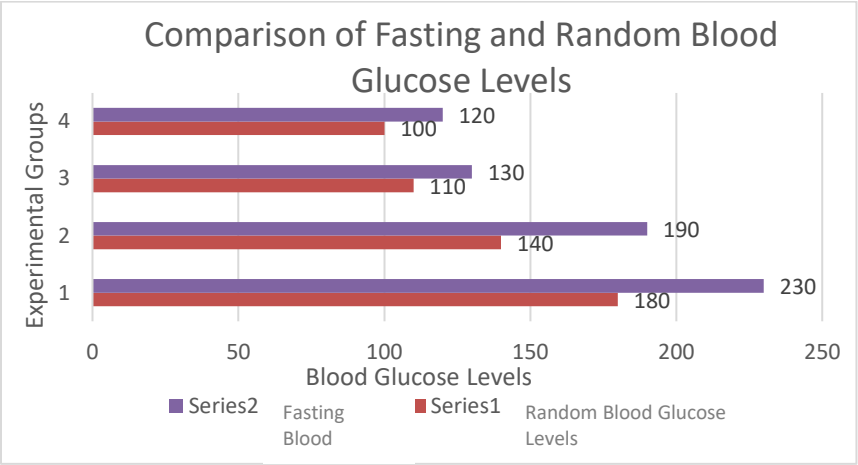

Figure 2. Bar Chart of Comparison of Fasting and Random Blood Glucose Levels

Figure 2 shows the comparison of fasting and random blood glucose levels of all experimental groups and control group. According to the bar chart the experimental group 2 shows the significant effect on fasting and random blood glucose levels of subjects as compared to experimental group 1, group 3 and control group. The therapeutic potential of Ficus carica has led to the extensive studies [22, 23] in recent years, focusing on evaluating and validating its pharmacological effect. The leaves of Ficus carica have remarkable health benefits involving antidiabetic activity

Sensory Evaluation

Taste of All Experimental Groups

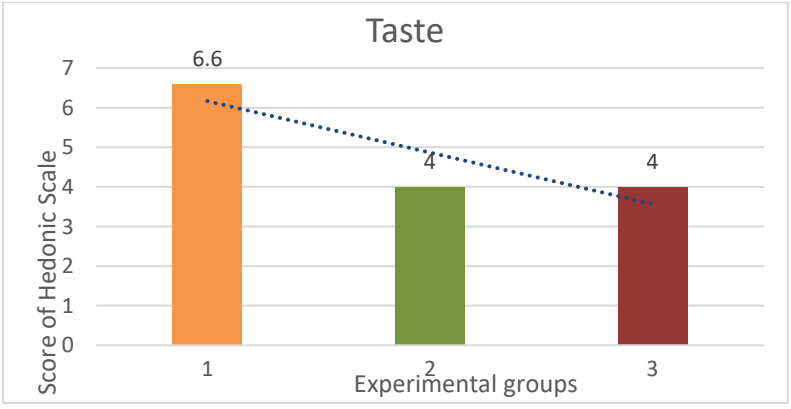

Figure 3. Bar Chart of Taste of All Experimental Groups

Figure 3 shows the taste of experimental group 1 (0 gm fig leaves), experimental group 2 (15 gm fig leaf powder) and experimental group 3 (20 gm fig leaf powder). According to the bar chart the group 1 (10 gm fig leaf powder) the score of taste was 6.6, group 2 (15 gm fig leaf powder) and group 3 (20 gm fig leaf powder) score was 4. Sensory evaluation is a scientific discipline used to evoke, measure, analyze and interpret reactions to those characteristics of foods and materials as they are perceived by the senses of sight, smell, taste, touch and hearing [24].

Table 7. Descriptive Analysis of Taste of All Groups

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
10 gm	5	6.60	.548	.245	5.92	7.28	6	7
15 gm	5	4.00	1.581	.707	2.04	5.96	2	6
20 gm	5	4.00	1.581	.707	2.04	5.96	2	6
Total	15	4.87	1.767	.456	3.89	5.85	2	7

Table 7 shows the descriptive means $\pm$ SD of all prepared samples. The mean and SD value of sample 1 (10 gm) was 6.60 and 0.548. The mean and SD value of sample 2 and 3 (15 gm, 20 gm) was 4 and 1.581 respectively.

Table 8. Analysis of Variance of Taste Between and Within Group

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	22.533	2	11.267	6.377	.013
Within Groups	21.200	12	1.767		
Total	43.733	14			

Table 8 indicates the significant value of 0.013 which means that there is a difference regarding taste between the three samples. Meaningful hypoglycaemic effect occurred in type II diabetes mellitus patients by consuming oral fig leaf powder regularly for 30 days [25]. Blood glucose level was decreased by the consumption of fig leaves.

Table 9. Multiple Comparison of Taste of All Experimental Groups

(I) Composition		(J) Composition		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	10 gm	dimension3	15 gm	2.600*	.841	.023	.36	4.84
			20 gm	2.600*	.841	.023	.36	4.84
	15 gm	dimension3	10 gm	-2.600*	.841	.023	-4.84	-.36
			20 gm	.000	.841	1.000	-2.24	2.24
	20 gm	dimension3	10 gm	-2.600*	.841	.023	-4.84	-.36
			15 gm	.000	.841	1.000	-2.24	2.24

*. The mean difference is significant at the 0.05 level.

The table 9 shows that there is a significant difference of taste when sample 1 (10 gm) was compared with sample 2 (15 gm) and sample 3 (20 gm). Sample 2 (15 gm) was significantly different from the sample 1 (10 gm) but not from the sample 3 (20 gm). The sample 3 (20 gm) was significantly different from the sample 1 (10 gm) but not from the sample 2 (15 gm).

Appearance of All Experimental Groups

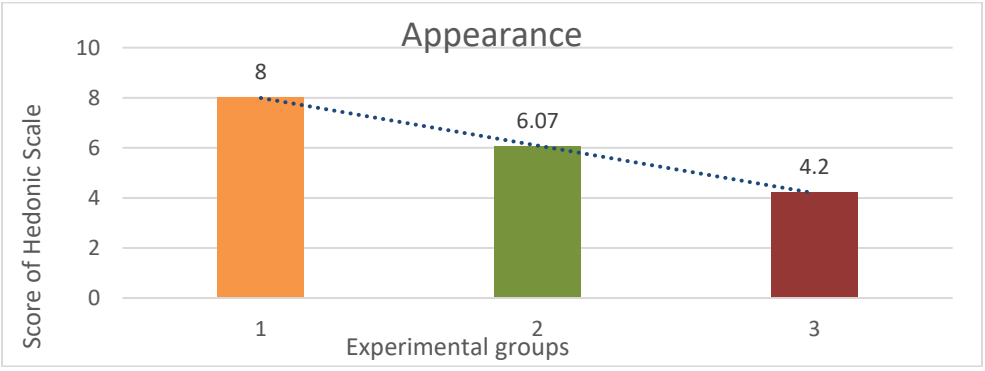

Figure 4. Bar Chart of Appearance of All Experimental Groups

Figure 4 shows the appearance of experimental group 1 (10 gm fig leaves), experimental group 2 (15 gm fig leaf powder) and experimental group 3 (20 gm fig leaf powder). According to the bar chart the group 1 (10 gm fig leaf powder) the score of appearance was 8, group 2 (15 gm fig leaf powder) the score was 6.07 and group 3 (20 gm fig leaf powder) score was 4.2. The bar chart depicts that group 1 (10 gm fig leaves) appearance was the most liked.

The appearance of 2nd group was slightly liked and 3rd group appearance was disliked.

Table 10. Descriptive Analysis of Appearance of All Groups

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
10 gm	5	8.00	1.000	.447	6.76	9.24	7	9
15 gm	5	7.60	1.140	.510	6.18	9.02	6	9
20 gm	5	4.20	1.924	.860	1.81	6.59	2	7
Total	15	6.60	2.197	.567	5.38	7.82	2	9

Table 10 shows the descriptive means ± SD of all prepared samples. The mean and SD value of sample 1 (10 gm) was 8.00 and 1.00. The mean and SD value of sample 2 (15 gm) was 7.60 and 1.140. The mean and SD value of sample 3 (20 gm) was 4.20 and 1.92. [26] studied the effect of fig leaf decoction (*Ficus carica).* It has been observed in type II patients with insulin-structured diabetes mellitus (IDDM) (six men, four women, 22-38 years of age). The application of *Ficus carcia* to IDDM diet may help to regulate postprandial glycaemia.

Table 11. Analysis of Variance of Samples Between Groups

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	43.600	2	21.800	10.900	.002
Within Groups	24.000	12	2.000		
Total	67.600	14			

Table 11 indicates the significant value of 0.002 which means that there is a difference regarding appearance between the three samples.

Table 12. Multiple Comparisons of Appearance of All Experimental Groups

(I) Composition		(J) Composition		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	10 gm	dimension3	15 gm	.400	.894	.897	-1.99	2.79
			20 gm	3.800*	.894	.003	1.41	6.19
	15 gm	dimension3	10 gm	-.400	.894	.897	-2.79	1.99
			20 gm	3.400*	.894	.007	1.01	5.79
	20 gm	dimension3	10 gm	-3.800*	.894	.003	-6.19	-1.41
			15 gm	-3.400*	.894	.007	-5.79	-1.01

*. The mean difference is significant at the 0.05 level.

The table 12 shows that there is not a significant difference of appearance when sample 1 (10 gm) was compared with sample 2 (15 gm) but there was a significant difference in appearance between sample 1 (10 gm) and sample 3 (20 gm). Sample 2 (15 gm) was not significantly different from the sample 1 (10 gm) but was significantly different from the sample 3 (20 gm). The sample 3 (20 gm) was significantly different from the sample 1 (10 gm) and sample 2 (15 gm).

Flavor of All Experimental Groups

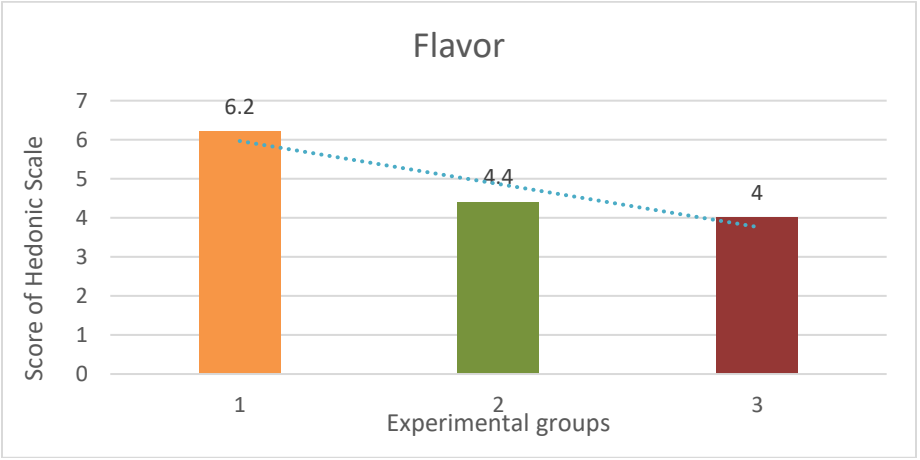

Figure 5. Bar Chart of Appearance of All Experimental Groups

Figure 5 shows the flavor of experimental group 1 (10 gm fig leaves), experimental group 2 (15 gm fig leaf powder) and experimental group 3 (20 gm fig leaf powder). According to the bar chart the group 1 (10 gm fig leaf powder) the score of flavor was 6.2, group 2 (15 gm fig leaf powder) the score was 4.4 and group 3 (20 gm fig leaf powder) score was 4. The bar chart represents that group 1 (10 gm fig leaves) flavor was the most liked. The flavor of 2nd and 3rd group appearance was disliked. Sensory evaluation has played an integral role in quality control (QC) for decades [27].

Table 13. Descriptive Analysis of Flavour of All Groups

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
10 gm	5	6.20	.837	.374	5.16	7.24	5	7
15 gm	5	4.40	1.140	.510	2.98	5.82	3	6
20 gm	5	4.00	1.581	.707	2.04	5.96	2	6
Total	15	4.87	1.506	.389	4.03	5.70	2	7

Table 13 shows the descriptive means ± SD of all prepared samples. The mean and SD value of sample 1 (10 gm) was 6.20 and 0.837. The mean and SD value of sample 2 (15 gm) was 4.40 and 1.140. The mean and SD value of sample 3 (20 gm) was 4.00 and 1.581.

Table 14. Analysis of Variance of Flavour of All Groups

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	13.733	2	6.867	4.578	.033
Within Groups	18.000	12	1.500		
Total	31.733	14			

Table 14 indicates the significant value of 0.03 which means that there is a difference regarding flavor between the three samples.

Table 15. Multiple Comparisons of Flavour of All Experimental Groups

(I) Composition	(J) Composition		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
dimension2	10 gm	dimension3	15 gm	1.800	.775	.091	-.27	3.87
			20 gm	2.200*	.775	.037	.13	4.27
	15 gm	dimension3	10 gm	-1.800	.775	.091	-3.87	.27
			20 gm	.400	.775	.865	-1.67	2.47
	20 gm	dimension3	10 gm	-2.200*	.775	.037	-4.27	-.13
			15 gm	-.400	.775	.865	-2.47	1.67

*. The mean difference is significant at the 0.05 level.

The table 15 shows that there is a significant difference of flavour when sample 1 (10 gm) was compared with sample 2 (15 gm) and sample 3 (20 gm). Sample 2 (15 gm) was significantly different from the sample 1 (10 gm) but was not significantly different from the sample 3 (20 gm). The sample 3 (20 gm) was significantly different from the sample 1 (10 gm) but not from sample 2 (15 gm).

Texture of All Experimental Groups

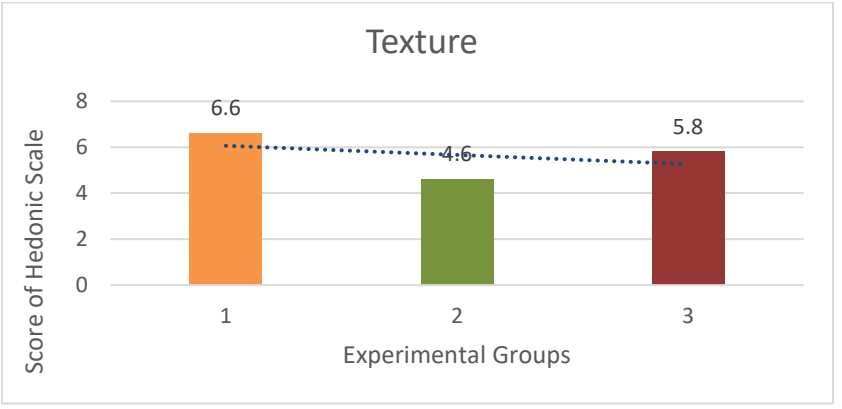

Figure 6. Bar Chart of Texture of All Experimental Groups

Figure 6 shows the texture of experimental group 1 (10 gm fig leaves), experimental group 2 (15 gm fig leaf powder) and experimental group 3 (20 gm fig leaf powder). According to the bar chart the group 1 (10 gm fig leaf powder) the score of texture was 6.6, group 2 (15 gm fig leaf powder) the

score was 4.6 and group 3 (20 gm fig leaf powder) score was 5.8. The bar chart represents that group 1 (10 gm fig leaves) texture was the most liked. The texture of 2nd and 3rd group appearance was disliked. Sensory evaluation has played an integral role in quality control (QC) for decades (Meilgaard *et al.*, 2007).

Table 16. Descriptive Analysis of Texture of All Experimental Groups

					95% Confidence Interval for Mean			
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
10 gm	5	6.60	.548	.245	5.92	7.28	6	7
15 gm	5	4.60	2.302	1.030	1.74	7.46	2	7
20 gm	5	5.80	1.924	.860	3.41	8.19	3	8
Total	15	5.67	1.839	.475	4.65	6.68	2	8

Table 16 shows the descriptive means ± SD of all prepared samples. The mean and SD value of sample 1 (10 gm) was 6.60 and 0.548. The mean and SD value of sample 2 (15 gm) was 4.60 and 2.302. The mean and SD value of sample 3 (20 gm) was 5.80 and 1.924.

Table 17. Analysis of Variance of Texture Between and Within Groups

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	10.133	2	5.067	1.634	.236
Within Groups	37.200	12	3.100		
Total	47.333	14			

Table 17 indicates the non-significant value of 0.234 which means that there is not a difference regarding texture between the three samples.

Table 18. Multiple Comparisons of Texture of All Experimental Groups

(I) Composition	(J) Composition		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
dimension2	10 gm	15 gm	2.000	1.114	.212	-.97	4.97
		20 gm	.800	1.114	.758	-2.17	3.77
	15 gm	10 gm	-2.000	1.114	.212	-4.97	.97
		20 gm	-1.200	1.114	.545	-4.17	1.77
	20 gm	10 gm	-.800	1.114	.758	-3.77	2.17
		15 gm	1.200	1.114	.545	-1.77	4.17

The table 18 shows that there is a non-significant difference of texture when sample 1 (10 gm) was compared with sample 2 (15 gm) and sample 3 (20 gm). Sample 2 (15 gm) is also non-significantly different from the sample 1 (10 gm) and sample 3 (20 gm). The sample 3 (20 gm) is also non-significantly different from the sample 1 (10 gm) and sample 2 (15 gm).

Overall Acceptability of All Experimental Group

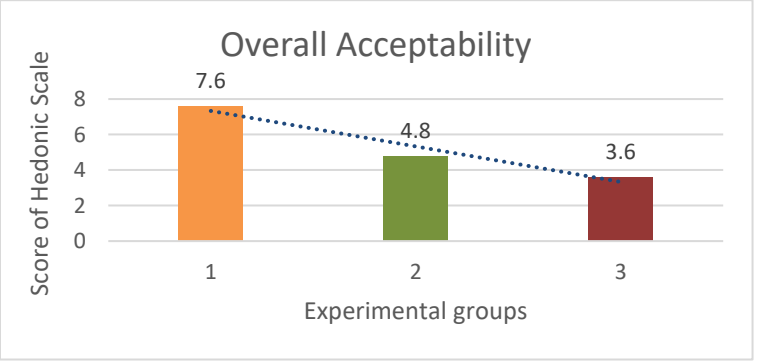

Figure 7. Bar Chart of Overall Acceptability of All Experimental Groups

Figure 7 shows the overall acceptability of experimental group 1 (10 gm fig leaves), experimental group 2 (15 gm fig leaf powder) and experimental group 3 (20 gm fig leaf powder). According to the bar chart the group 1 (10 gm fig leaf powder) the score of texture was 7.6, group 2 (15 gm fig leaf

powder) the score was 4.8 and group 3 (20 gm fig leaf powder) score was 3.6. The bar chart represents that group 1 (10 gm fig leaves) texture was the most liked. The overall acceptability of 2nd and 3rd group was disliked. Sensory evaluation has played an integral role in quality control (QC) for decades (Meilgaard *et al.*, 2007).

Table 19. Descriptive Analysis of Overall Acceptability

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
10 gm	5	7.60	.548	.245	6.92	8.28	7	8
15 gm	5	4.80	1.304	.583	3.18	6.42	3	6
20 gm	5	3.60	.894	.400	2.49	4.71	3	5
Total	15	5.33	1.952	.504	4.25	6.41	3	8

Table 19 shows the descriptive means ± SD of all prepared samples. The mean and SD value of sample 1 (10 gm) was 7.60 and 0.548. The mean and SD value of sample 2 (15 gm) was 4.80 and 1.304. The mean and SD value of sample 3 (20 gm) was 3.60 and 1.952.

Table 20. Analysis of Variance of Overall Acceptability Between and Within Groups

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	42.133	2	21.067	22.571	.000
Within Groups	11.200	12	.933		
Total	53.333	14			

Table 20 indicates the significant value of 0.000 which means that there is an overall difference between the three samples.

The table 21 shows that there is an overall significant difference when sample 1 (10 gm) was compared with sample 2 (15 gm) and sample 3 (20 gm).

Table 21. Multiple Comparisons of Overall Acceptability of All Experimental Groups

(I) Composition		(J) Composition		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
dimension2	10 gm	dimension3	15 gm	2.800*	.611	.002	1.17	4.43
			20 gm	4.000*	.611	.000	2.37	5.63
	15 gm	dimension3	10 gm	-2.800*	.611	.002	-4.43	-1.17
			20 gm	1.200	.611	.164	-.43	2.83
	20 gm	dimension3	10 gm	-4.000*	.611	.000	-5.63	-2.37
			15 gm	-1.200	.611	.164	-2.83	.43

*. The mean difference is significant at the 0.05 level.

Sample 2 (15 gm) was significantly different from the sample 1 (10 gm) but was non-significantly different from the sample 3 (20 gm). The sample 3 (20 gm) was significantly different from the sample 1 (10 gm) and non-significantly different from sample 2 (15 gm).

Overall Result of Sensory Evaluation

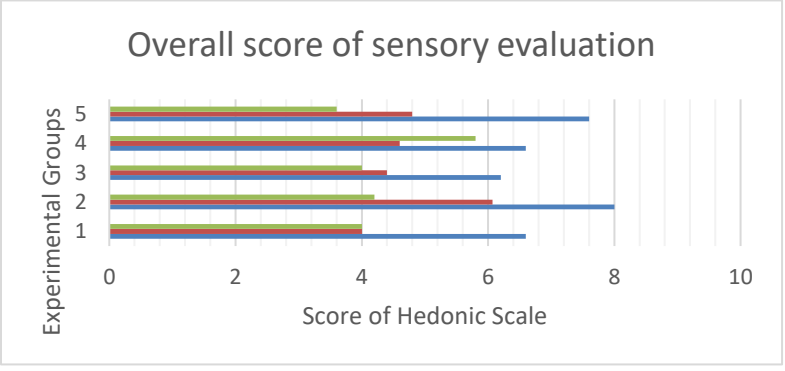

Figure 8. Overall Score of Sensory Evaluation of All Experimental Groups

The figure 8 depicts the overall score of sensory evaluation of all experimental groups. The systematic study of human reaction to physico-chemical properties has been studied to enable knowledge on the sensitivity of the human sense and the four dimensions of sensory experience, i.e. the quantitative, qualitative, temporal and hedonic aspects [28].

Conclusion

In conclusion, chapattis developed with 10 gm of fig leaves were beneficial for Diabetic patients to maintain the blood glucose levels. Moreover, chapattis prepared with 15 gm of fig leaves were helpful in lowering the blood glucose levels along with medicines. Sample with 10 gm fig leaves was accepted for all for its sensory properties. Nutritional profile of chapattis prepared with fig leaves was much better as compared to the whole wheat chapattis.

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