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EXPLORING THE THERAPEUTIC POTENTIAL OF *MOMORDICA CHARANTIA* (BITTER GOURD) IN THE MANAGEMENT OF DIABETES MELLITUS

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ABSTARCT
Bitter gourd is an important vegetable which has been used to control blood glucose levels. It possesses a unique set of biologically active components such as charantin, vicine and polypeptide-p that exhibit anti-oxidative and hypoglycaemic potential. Since time immemorial, herbal plants and home-grown plants have been used as a source of alternative medicines; *Momordica charantia* (bitter gourd) is one of them which are generally used for medicinal purposes in many countries of the world, especially in the subcontinent.
In this research, bitter gourd has been used in raw, crushed and powdered form to perform the chemical and physical analysis in which the researchers determined its moisture and ash content, crude fat, fiber and protein, nitrogen free extract (NFE) along-with the determination minerals. These experiments were done with different methods using different apparatuses. Afterwards, *Momordica charantia* was made into a supplement form and added in four chapattis with different concentrations to determine its effect on diabetic rats. Before experimenting, the sensory (texture, color and taste) evaluation of the chapattis was also performed.
This study confirms the significance of *Momordica charantia* powder in regulating sugar levels, highlighting its high nitrogen-free extract, protein, and fiber content. Moreover, the bitter gourd demonstrated higher quantities of calcium, iron, copper, and zinc compared to other minerals. Incorporating *Momordica charantia* into daily dietary habits can effectively lower both fasting and random blood glucose levels, showcasing its positive impact on blood sugar regulation.

Keywords: Bitter gourd, *Momordica charantia*, diabetes, bioactive component, antioxidants.

Momordica charantia, commonly known as sharp melon or Bitter gourd, has a variety of other names in the world, for example, resin pear (English), Karalla (Hindi or Urdu), Nigauri or Goya (Japanese), Ku gua (Mandarin), Koguai (Taiwanese), Kho qua (Vietnamese), Ampalaya (Filipino), and Assorossie (French). The scientific name Momordica means “to bite” which refers to the leaf of the bitter melon plant that has rough edges belonging to the blooming plant of the family Cucurbitaceous. Momordica charantia is a plant that is usually utilized for medication purposes.

Although Karalla is a yearly plant usually grown in mid-summer, its good production can be achieved by developing it as a permanent yield (Mikstas, 2022 and Mirani *et al.*, 2012)

Classification of Momordica charantia ((Center for Aquatic and Invasive Plants, 2023)

Kingdom	***Plantae***
Clade	***Rosids***
Clade	***Eudicots***
Order	***Cucurbitales***
Family	Cucurbitaceae
Genus	***Momordica L.***
Species	***M. charantia***

The replacement of medicines with regular food products that have medicinal and therapeutic potential is now trending in the world. The biologically active compounds which are present in the vegetable are commonly used for this purpose since they are useful in creating innovative remedies. Like other therapeutic plants, *Momordica charantia* is also found to have treatment for numerous ailment properties with a scope of restorative qualities (Saeed et al., 2018). Generally speaking, *Momordica charantia* is already being used for its medicinal purposes in many countries of the world (Tan, 2019). This type of vegetable is typically grown in India, South America, Asia and East Africa, with nutraceutical potential in terms of its utilization against diabetes and other diseases (Khandelwal, 2022). It is an organic product guaranteed to contain remedial impacts because of its beneficial substances and bioactive components. Bitter gourd lowers glucose levels through its different mechanisms in which the prevention of glucose retention is the most important in the alimentary canal, thus improving the glucose uptake by tissues, increasing the glucose metabolism, and enhancing insulin activity and pancreatic beta-cell stimulation (Gayathry & John, 2022).

Diabetes mellitus is the most common disorder prevalent in developed and developing countries which are increasing rapidly in most parts of the world. In Type I diabetes, the β-cells of the pancreas do not make adequate insulin while Type II diabetes is the real type of diabetes that represents roughly 90–95% of all diabetic cases. This type of diabetes starts with insulin resistance, a condition in which muscle, liver and fat cells do not react to insulin properly. As a result, the pancreas loses its capacity to produce enough insulin that can absorb glucose (Joseph and Jini, 2013). Glucose in the blood is unable to absorb, hence, the glucose level increases in the blood. Continuous high levels of blood glucose, otherwise called hyperglycemia, can harm nerves and veins that result in further complications, for example, coronary illness, stroke, kidney dysfunction, visual deficiency, nerve damage, gum diseases and removal (Alam Uddin *et al.*, 2015 and Griffith & Nicohls, 2023). Gestational diabetes is another form of diabetes that occurs due to hormonal changes or insulin deficiency during pregnancy. Insulin induction, glucose-lowering medications and lifestyle changes, for example, workouts, weight control, changes in dietary habits and regular treatment, are suggested for treating diabetes (2023).

Momordica charantia (Bitter gourd) has been placed in the class of plants with the pan-tropical appropriation that contains diabetes-lowering substances such as polypeptide-p, vicine and charantin along with additional non-specific bioactive components such as antioxidant. Some other phytochemical compounds that are found in Karalla include amino acids such as aspartic acid, serine, glutamic acid, threonine, alanine, g-amino butyric acid and phenolic acid, lutein (Anilakumar et al., 2015). The most common use of bitter gourd is as the anti-diabetic agent (Farooq et al., 2019). The properties of Bitter gourd which are responsible for metabolic and hypoglycemic impacts have been exhibited in cell culture, animal, and human evaluations. The mechanism of activity that, controls insulin discharge or adjusted glucose digestion and its insulin-like impact, is still under the level of discussion (Griffith & Nicohls, 2023).

1. METHODS AND MATERIALS

The purpose of the study was to determine the impact of Momordica charantia powder against hypoglycemic rats. At first chemical analysis of Momordica charantia powder was found. Momordica charantia was used as a treatment apparatus and wheat flour complemented chapatti with Momordica charantia powder laterally given with their normal food. The investigational rats were endorsed to bring supplemented chapatti with Momordica charantia powder two times each day. The plasma glucose of rats was carefully observed throughout the purpose of the research to estimate the impact of Momordica charantia powder on diabetes. The resultant data were linked with controlled group to draw conclusions.

2.1. Procurement of Raw Material

The Momordica charantia was acquired from Ayub Agricultural Research Institute Faisalabad. Wheat flour was purchased from local market.

2.2. Development of Momordica charantia powder

Momordica charantia was washed to remove dust and after that it was cut into pieces. These Momordica charantia pieces were sundried and afterward they were turned into powdered form by utilizing an electric processor.

2.3. Chemical analysis of powder

2.3.1. Proximate analysis

The proximate investigation of Momordica charantia powder were performed in different labs for proximate analysis examination for humidity, ash content, rough protein, unrefined fat, rough fiber and nitrogen free concentrate (NFE), founded by the protocol described by (AOAC). The whole test was done in National Institute of Food Science and Technology (NIFSAT), University of Agriculture, Faisalabad

2.3.1. Moisture Content

The moisture content of Momordica charantia powder was controlled through broiler ventilation strategy. 5g of sample was taken in clean, dried crucible and was put in a broiler at a temperature of 105 ± 5°C for 24 hours until a steady weight was founded. After that, it was put in desiccator for around 15-30 minute and weighted once again when it was cooled down. The present moisture was founded by the method described by the AACC (2000).

2.3.2. Ash Content

In assurance of ash substance, the weight was measured on the clean crucible (10g). The sample was placed in the muffle furnace where a temperature of 550°C was kept up till the sample turned into grayish color which demonstrated that oxidation of all natural matter was finished. Then crucible was chilled off by putting it in the desiccator for around 15-30 minutes. At that point, the sample was again weighted to quantify the losses. Each sample was verified for ash contented by following the procedure as described by the AACC (2000).

2.3.3. Crude Fat

The Soxhlet apparatus was used for measuring the quantity of crude fat in the sample. The procedure for the determination of crude fat is described by AACC (2000). Dehydrated extraction strategy for fat assurance was suggested. It comprised of separating dehydrated specimen via natural, dissolvable, meanwhile all fat ingredients e.g., fats, phospholipids, sterols, greasy acids, carotenoids, pigments, chlorophyll and so on, were extricated together, thus the outcomes were much of the time alluded to such as crude fat. The extraction of fats was done using a soxhlet extraction apparatus, which involves using an ether extraction method. Around 5g of the moisture-free sample was placed in filter paper, then set in a thimble and inserted into the extraction tube. A measuring utensil containing oil ether was used and fitted into the apparatus. The water and the

heater were turned on to begin the extraction process. After 7-8 cycles, the ether was allowed to evaporate, and the measuring utensil was detached before the final cycle. The fat-free sample was removed and placed in a warm air oven for complete dehydration for approximately 15-30 minutes. After cooling, the sample is weighed for the final reading to determine the fat content.

2.3.4. Crude Fiber

Unrefined fiber was assessed by convention method as portrayed by AACC (2000). After following the procedure of AOAC, the crude fiber content was calculated according to following formula:

$$Crude\ Fibre\ \% = \frac{\text{weight of ether extract}}{weight\ of\ sample} \times 100$$

2.3.5. Crude Protein Contented

Protein ratio in the sample was determined by the Kjehdahl technique as defined (AACC, 2000). Nitrogen that was obtained from the protein was changed in to ammonium sulfate. After ammonia was purified with typical boric acid, the total percentage of nitrogen was calculated. For determination of protein content, following steps were performed:

Digestion

The sample was put in a flask with a digestion tablet and 25ml sulfuric acid to start the digestion. It took 6-8 hours to achieve light green color. After cooling the contents down, 100ml refined H2O was added gradually, while maintaining a strategic distance from any exorbitant warmth generation, and transferred to a 100ml volumetric cup. The flask was washed 2-3 times, ensuring complete sample recovery, and the volume was adjusted to 10ml.

Distillation

Digested sample (10ml) was refined with 10ml of 40% NaOH in a small-scale Kjeldahl distillation setup. It was timely noted when the distillate, collected in a 10ml 4% boric acid solution with 2-3 drops of methyl red indicator, changed from red to yellow. The refining was proceeded for 2-3 minutes to ensure the maximum possible amount was captured in the solution until foaming had ceased.

Titration

The substance of flask was titrated against 0.1 NHCL till pink shade when end point was recaptured. The crude protein was resolved by the convention method depicted by AACC (2000). The rate of unrefined protein was figured by taking after expression. The nitrogen proportion was controlled by the accompanying expression.

$$Nitrogen\ \% = \frac{\text{Titer of 0.1 N H2SO4 used } \times\ 0.0014 \times\ 250}{weight\ of\ sample} \times 100$$

2.3.6. Nitrogen free extract

Nitrogen Free Extract (NFE) was measured according to the method described by the AACC.

2.3. Determination of Minerals

Mineral i.e. calcium, Iron, and zinc were determined by atomic absorption spectrophotometer by taking after the convention portrayed by AOAC (2006). Different components included sodium were assessed through the Flame Photometer-410 (Sherwood Scientific Ltd., Cambridge).

2.3.1. Wet digestion

0.5g of the crushed sample was taken in a handling flask. 10ml of Nitric Acid and 5.0ml of each chloric acid (HCIO4) were added to the flask, creating a mixture. The flask was placed on a hot plate for digestion. The temperature was gradually increased from 50°C up to 250-300°C. Digestion was completed within 30-40 minutes, indicated by the appearance of white fumes. The mixture was

left to cool for some time, and then its contents were transferred to 100ml volumetric cups. The volume was made up to 100ml with distilled water. The wet processed sample was transferred to marked plastic jugs for storage and future use in mineral determination. Calcium and iron content were analyzed using an Atomic Absorption Spectrophotometer (Hitachi Polarized Zeeman AAS, Z-8200, Japan) following the protocol outlined by AOAC (2006). Sodium and potassium levels were assessed using the Flame Photometer-410 (Sherwood Scientific Ltd., Cambridge).

2.3.2. Standards Preparation

Calibrate standards were readied the industrially accessible stock arrangement as a fluid arrangement. Very purged de-ionized liquid was used for the arrangement of working measures.

2.4. Momordica charantia supplemented chapattis

Treatment	Powder Concentration %
T0	0
T1	2
T2	4
T3	6

2.4.1. Preparation of Momordica charantia Supplemented Chapattis

With the help of wheat flour and Momordica charantia powder, four chapattis were made. First chapatti contains 100% wheat flour and the remaining three were prepared through the altered concentration of Momordica charantia powder (2%, 4%, and 6%). Chapatti was prepared by mixing flour, salt and bubbled cool liquid that in a way that an appropriate uniformity was formed without sticking to the dish. The dough, then, was separated into little balls and levelled to get a round molded roti. Roti were set on a round roti dish and flipped around the fire for 10 minutes at 2 minutes intervals till the external surface becomes dark in color.

2.5. Proximate analysis of Momordica charantia Supplemented Chapattis

The proximate investigation of Momordica charantia supplemented chapattis was also performed in different labs. During proximate analysis examination of humidity, ash content, rough protein, unrefined fat, rough fiber and nitrogen free concentrate (NFE) of Momordica charantia chapattis were founded by the protocol described by (AOAC). The whole test was done in National Institute of Food Science and Technology (NIFSAT), University of Agriculture, Faisalabad.

2.6. Sensory evaluation

Sensory evaluation of wheat flour and bitter gourd powder supplemented chapattis (To, T1, T2, and T3) were carried out by, employing 9-point hedonic scale (9 = like extremely; 1 = dislike extremely). According to this scale, sensory response for various qualities like color, texture, and overall acceptability were recorded.

2.7. Statistical Analysis

The result was achieved by using completely randomized design (CRD) to find the mean value.

2. RESULTS

3.1. Proximate examination of raw material

Primary investigation of *Momordica charantia* residue has been supported out for determination of moisture, protein, crude fat, crude fiber, ash and nitrogen free extract respectively.

Table 3.1: Mean ± S.D for proximate composition of *Momordica charantia* powder and wheat flour supplemented chapattis

Treatment	Moisture	Crude Protein	Crude Fat	Fiber	Ash	NFE
Bitter powder	7±.150	18.01±.134	.45±.012	15.13±.431	5.71±.180	52.21±1.217
Chapatti(T0)	12.01±.01	12.08±.1096	1.71±.0529	1.97±.0416	1.31±.0404	74.9±.2170
Chapatti(T1)	11.17±0.1530	11.7±0.3360	1.55±0.2030	2.21±0.2103	1.38±0.1307	71.97±0.394
Chapatti(T2)	10.21±0.1357	12.58±0.6619	1.38±0.0945	2.45±0.0832	1.52±0.0953	71.84±0.6524
Chapatti(T3)	10±0.02	13.17±0.1680	1.24±0.0793	2.59±0.0358	1.61±0.1097	71.38±0.3

3.1.1. Moisture content

The proximate examination of *Momordica charantia* powder demonstrated that *Momordica charantia* powder contains 7±.150 % moisture. Wheat flour chapatti comprise 12.01±.01% moisture and *Momordica charantia* powder complemented chapattis T1, T2 and T3 hold 11.17±.5130%, 10.21±.1357% and 10±0.02% moistness separately. That was appeared in the Table. 3.1 The *Momordica charantia* powder was a genuinely low moisture substance then the supplemented chapattis. Investigation of difference of dampness substance of *Momordica charantia* complemented chapattis was represented in fig. 3.1 that discovered huge. Mean ± SE of moisture substance of *Momordica charantia* residue and wheat flour complemented roti additionally appear and symbolized sketchily in Fig 3.1. The moisture content in leaf, fruit and seeds of *Momordica charantia* are (17.97±1.00%, 10.74±2.29% and 20.69±5.85%).

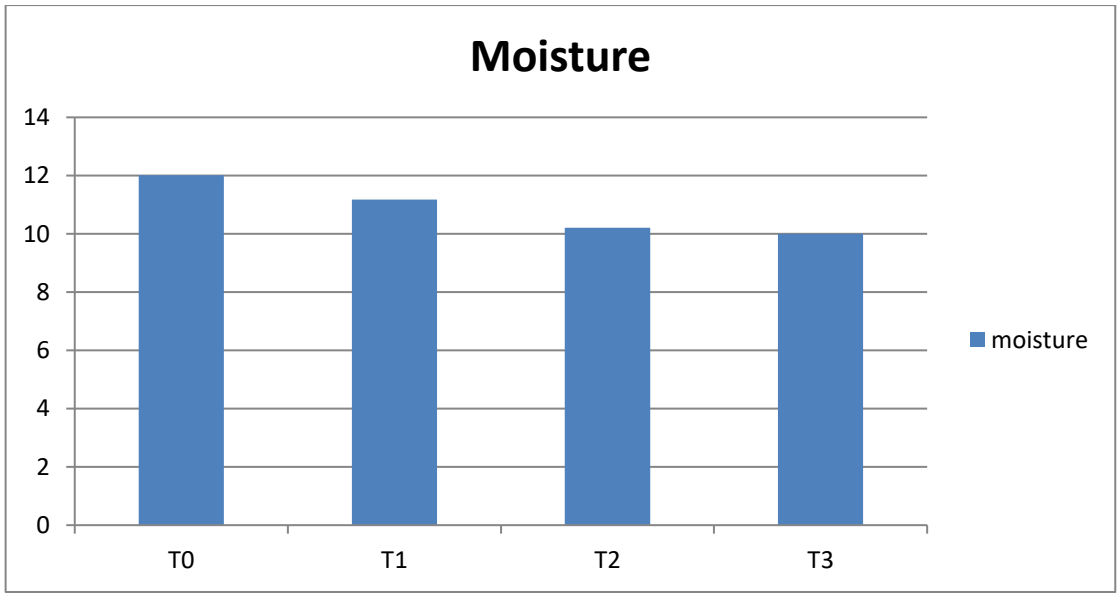

Figure 3.1: Graph of mean ± SD of variation in Moisture content of *Momordica charantia* powder and wheat flour supplemented chapattis

3.1.2. Crude Protein (%)

Consequence of research demonstrated that Momordica charantia powder contains 18.01±.134% rough protein. To 100% wheat flour chapatti comprise 12.08±.1096% unrefined protein and *Momordica charantia* powder supplemented chapatti T1, T2 and T3 cover 11.7±0.3360%, 12.58±0.6619% and 13.15±0.1680% rough protein separately. It was appeared in the Table. 3.1 That *Momordica charantia* powder was abnormal state of rough protein substance then the supplemented chapattis. Investigation of fluctuation of unrefined protein substance of *Momordica charantia* supplemented chapattis has been appeared in fig. 3.2 that was discovered critically. Mean ± SE of protein of *Momordica charantia* powder and wheat flour supplemented chapattis likewise appeared. The information has been additionally shown to graphically in Fig 3.2.

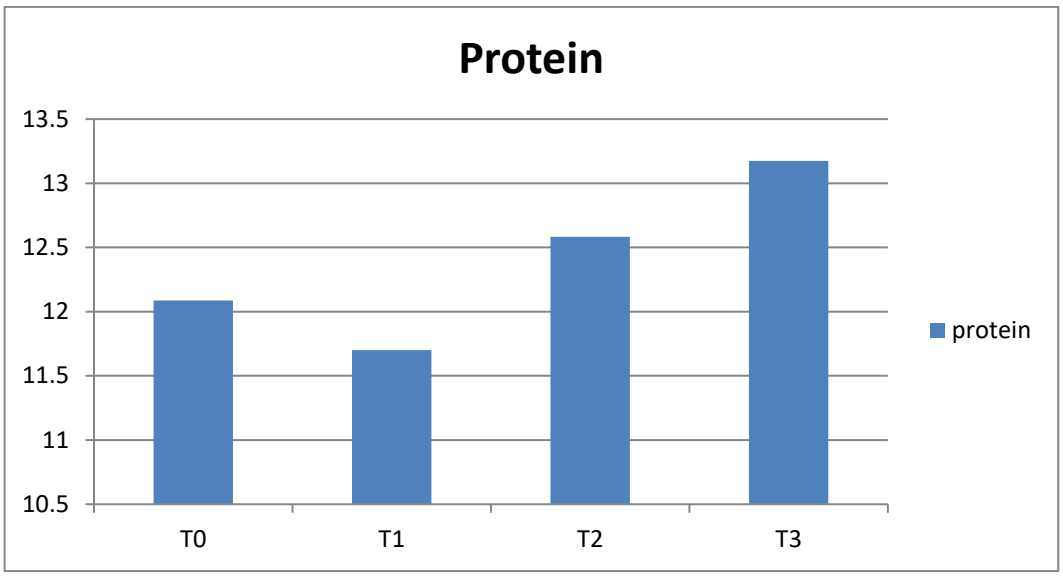

Figure 3.2 Graph of mean ± SD of variation in crude protein content of *Momordica charantia* powder and wheat flour supplemented chapattis

3.1.3. Crude Fat

In addition, many capacities in our study depend on greasy substances, so it was significant to include fat from various sources in our day by day diet for nourishment. Although fat substance was low in garlic, yet numerous fundamental oils were useful for appropriate working of numerous physiological exercises. The proximate investigation of biting gourd powder demonstrated that bitter gourd powder contains 0.45±0.11% fat. To 100% wheat flour chapatti contains 1.71±0.0529% unrefined fats and severe gourd supplemented chapatti T1, T2 and T3 contains 1.55±0.2030%, 1.38±0.0945% and 1.24+0.793% rough fat separately. In our discovering sharp gourd powder was low level of fat substance then the supplemented chapattis. It has been appeared in the fig. 3.3. Study of alteration of fat content of bitter gourd complemented roti has been shown and result found significant. The figures also symbolized sketchily in Fig 3.3

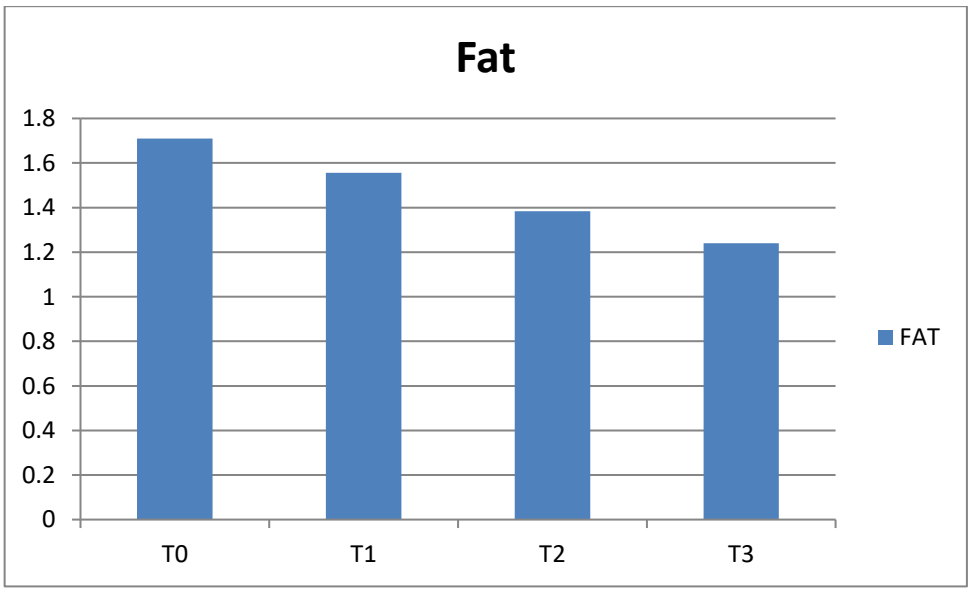

Figure 3.3: Graph of mean ± SD of variation in crude fat contented of bitter gourd powder and wheat flour supplemented chapattis

3.1.4. Crude Fiber

The effect of research demonstrated that karalla powder was 15.13+.431% unrefined fiber. To 100% wheat flour chapatti contains 1.97±0.0416% unrefined fats and *Momordica charantia* supplemented

chapatti T1, T2 and T3 contains 2.21±.2030%, 2.48±.0832% and 2.59±.0358 % rough fiber separately. In our discovery, bitter gourd powder was in abnormal state of fiber substance then the supplemented chapattis. It has been shown in the Table. 3.1 Examination of alteration of fiber content of *Momordica charantia* added chapattis has been shown in symbolized in detail in Fig 3.4.

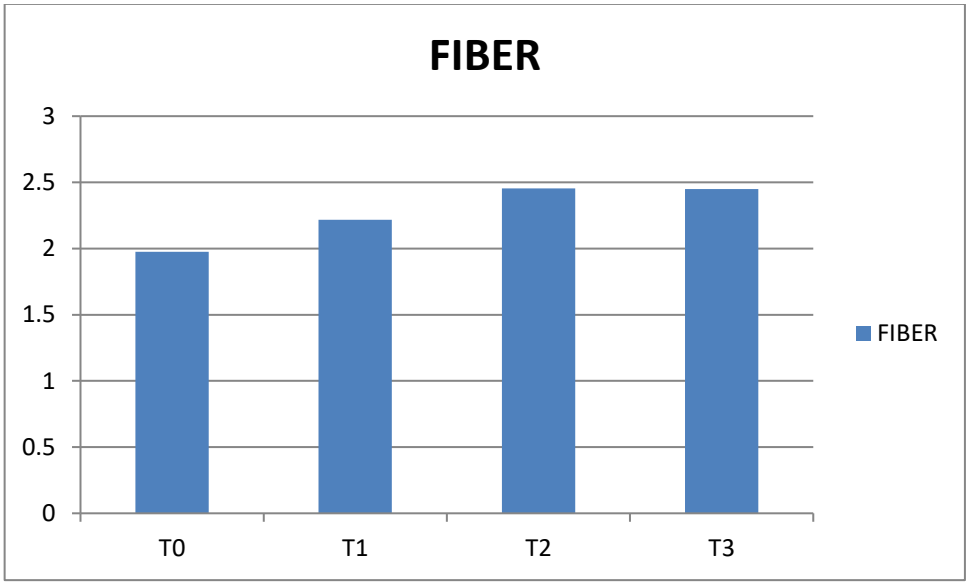

Figure 3.4: Graph of mean ± SD of variation in crude fiber content of *Momordica charantia* powder and wheat flour supplemented chapattis

3.1.5. Ash

The research has been demonstrated that karalla powder contains 5.71+.180% complete ash. To 100% wheat flour chapattis comprise 1.31±.0404% total ash and *Momordica charantia* powder complemented chapattis T1, T2 and T3 cover 1.38±0.1307%, 1.52±0.0953% and 1.61±.1097% overall ash correspondingly. The research evaluated that the karalla powder, that existed unexpectedly was great in total ash content. Study of alteration of overall ash in karalla powder and *Momordica charantia* added chapattis has also been symbolized sketchily in Fig 3.5.

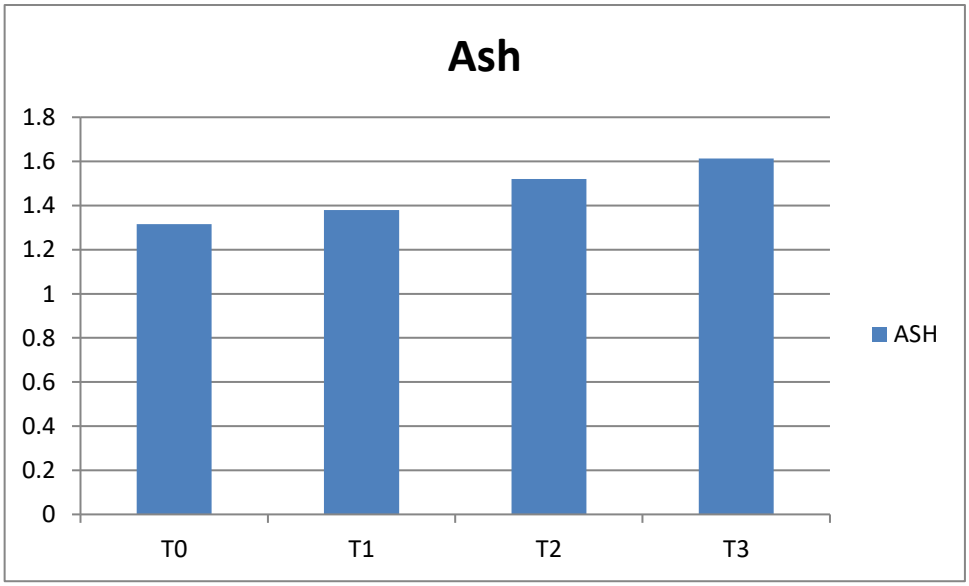

Figure 3.5: Graph of mean ± SD of variation in ash content of *Momordica charantia* powder and wheat flour supplemented chapattis

3.1.6. Nitrogen Free Extract

The research demonstrated that karalla powder contain 52.21+1.217% NFE. T0 100% wheat flour

chapatti contain 74.9±.2170% NFE and karalla powder added chapattis T1, T2 and T3 contain 71.97 ±.394% , 71.84 ±.6524% and 71.38 ± .3 % overall NFE correspondingly . The result showed wheat flour chapatti contains high NFE. It was shown in the Table .3.1. Investigation of alteration of NFE in karalla powder and *Momordica charantia* complemented chapattis was shown the result was found non-significant. The data was also symbolized sketchily as shown in Fig 3.6.

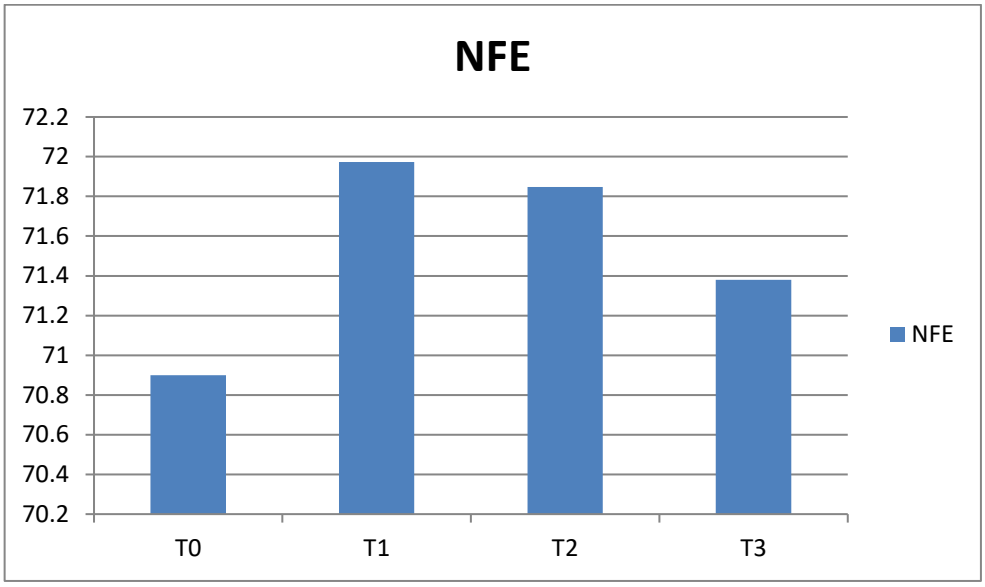

Figure 6: Graph of mean ± SD of variation in NFE content of *Momordica charantia* powder and wheat flour supplemented chapattis

3.2. Mineral analysis

Mineral investigation of the *Momordica charantia* powder and *Momordica charantia* supplemented chapattis shown their great quantity of Ca phosphorous and iron (Table 3.14). The ratio of calcium, phosphorus and iron in *Momordica charantia* powder was considerably high as compared to chapattis.

Table 3.2: Mineral Analysis of *Momordica charantia* powder and wheat flour supplemented chapattis (mg/100g)

Minerals	***Momordica charantia* powder**	**T1**	**T2**	**T3**
Iron	15.01±0.231	0.41±0.036	0.67±0.039	0.69±0.047
Calcium	16.38± 0.229	1.98±0.079	2.19±0.087	2.43±0.070
Sodium	22.08±0.0230	2.31±0.047	2.41±0.078	2.50±0.070
Zinc	0.40±0.05	0.03±0.0109	0.031±0.011	0.033±0.10

3.3. Sensory evaluation of chapattis

The sensory evaluation of *Momordica charantia* supplemented and wheat flour chapattis was conducted at room temperature under clear white light spectrum. On evaluation day, the *Momordica charantia* supplemented wheat flour chapattis were placed in crystal glass trays which were labelled with random codes. Panelists were provided distilled water rinsing their mouths between the judgments of each sample. The *Momordica charantia* chapattis samples were presented at random order and panelists were requested to rate their acceptance by providing score for all parameters at different time intervals. For sensory evaluation, chapattis were ranked using 9 points hedonic scale for their color, texture, taste and overall acceptability.

Mean squares shown in tables proved the effect of treatments, and their interaction on sensory characteristics of chapattis. It was observed that treatment has significant effect on sensory quality of chapattis. In all treatments (chapattis were prepared with *Momordica charantia* powder and wheat flour) whist interaction has non-momentous effect on all sensory traits. To shows controlled

chapattis and the following treatments are used to make chapattis.
To=100% wheat flour
T1=2% *Momordica charantia* powder and 98% wheat flour
T2=4% *Momordica charantia* powder and 96% wheat flour
T3=6% *Momordica charantia* powder and 94% wheat flour
The results are discussed below.

Table 3.3: Mean ± SE Values for Sensory Evaluation of *Momordica charantia* powder and wheat flour supplemented chapattis

Treatment	Taste	Color	Texture	Overall acceptability
T0	7.67±0.1101	7.24±0.2112	6.81±0.0211	7.10±01667
T1	6.79±0.1198	6.97±0.0881	5.95±0.0821	6.11±0.0857
T2	5.67±0.0891	5.97±0.0891	5.43±0.0811	5.10±0.0976
T3	4.58±0.0878	4.76±0.0771	3.99±0.0881	4.12±0.0968
Mean	6.20±0.103	6.26±0.059	5.61±0.3733	6.05±0.1141

3.3.1. Taste of chapattis

It is extremely considerable distinction among treatments. The chapattis with different concentration of *Momordica charantia* powder varying score for taste. It is concluded from the statistical analysis that to get marks for taste 7.67±0.1101 in contrast T1, T2 and T3. T1 got highest marks for taste of 6.79±0.1198 in contrast to T2 (5.67±0.0891) and T3 (4.58±0.0878).Fig (3.7) showed the taste of T1 (2% *Momordica charantia* powder and 98%wheat flour) got maximum marks among T2 and T3 treatments. The results were taste showed that the taste of chapattis became bitter significantly as the concentration of *Momordica charantia* powder increased. Mean for taste showed that maximum score for taste was assigned to T0 (7.67±0.1101) while minimum to T3 (4.58±0.0878).

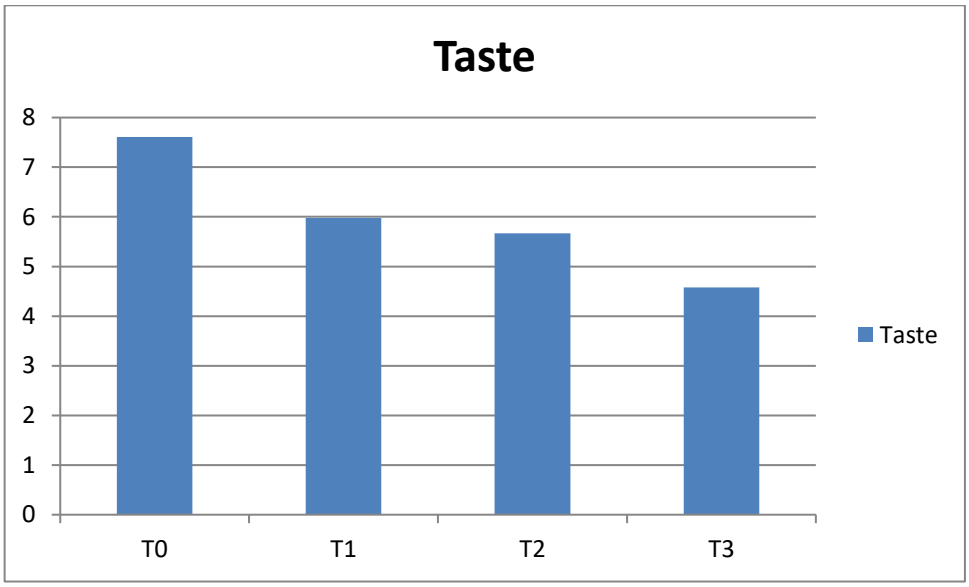

Figure 3.7: Graph of Mean ± SD of *Momordica charantia* powder and wheat flour supplemented chapttis

3.3.2. Color of chapattis

The result of color showed that it is extremely considerable distinction among treatment. The chapattis with different concentration of *Momordica charantia* powder having different score for color. T1 got highest marks for color 6.97+ 0.088 in contrast to T2 (5.97+0.0771) and T3 (4.76+0.059) fig. (3.8) showed the color of T1 (2% *Momordica charantia* powder and 98% wheat flour) got maximum marks among T2 and T3 treatments. With these result it was cleared that color of chapattis changed significantly as the bitter gourd powder concentration increased. Mean for

color showed that maximum score for color was assigned to T0 (7.38+0.186) while minimum to T3 (4.88+0.129).

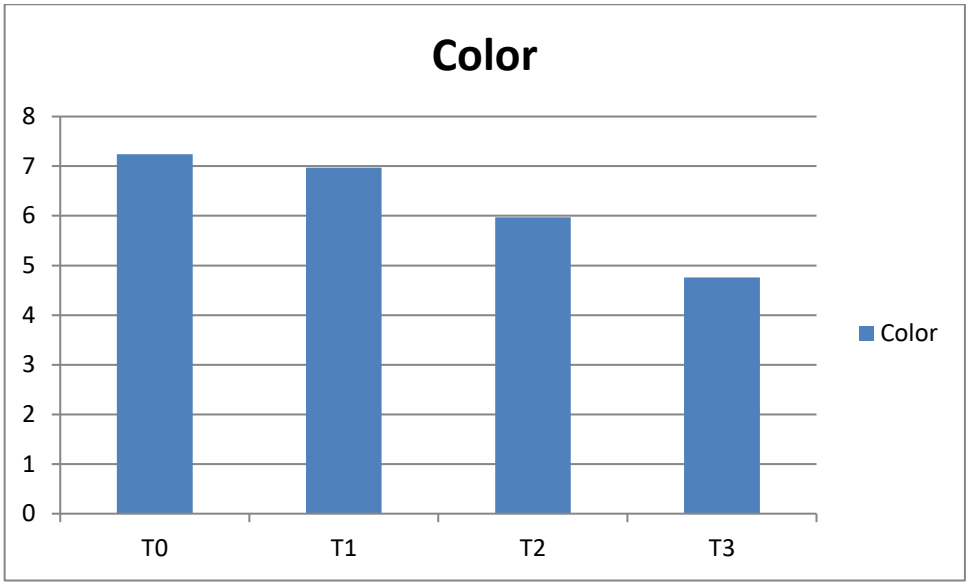

Figure 3.8: Graph of Mean ± SD of *Momordica charantia* powder and wheat flour supplemented chapattis

3.3.3. Texture of chapattis

The analysis of variance showed an extremely important variation among all treatments. Texture specifies the crusty expertise of the food products. For the chapattis texture maximum scores 6.81±0.0211 was noted for T0 while minimum for T1, T2 and T3 5.95±0.0821, 5.43±0.0811 and 3.99±0.0881. Results showed significant reduction from 6.78±0.171 to 4.88±0.123 in chapattis texture. Fig (3.9) proved that the control chapattis have good textures as compared to functional and nutraceutical-based chapattis.

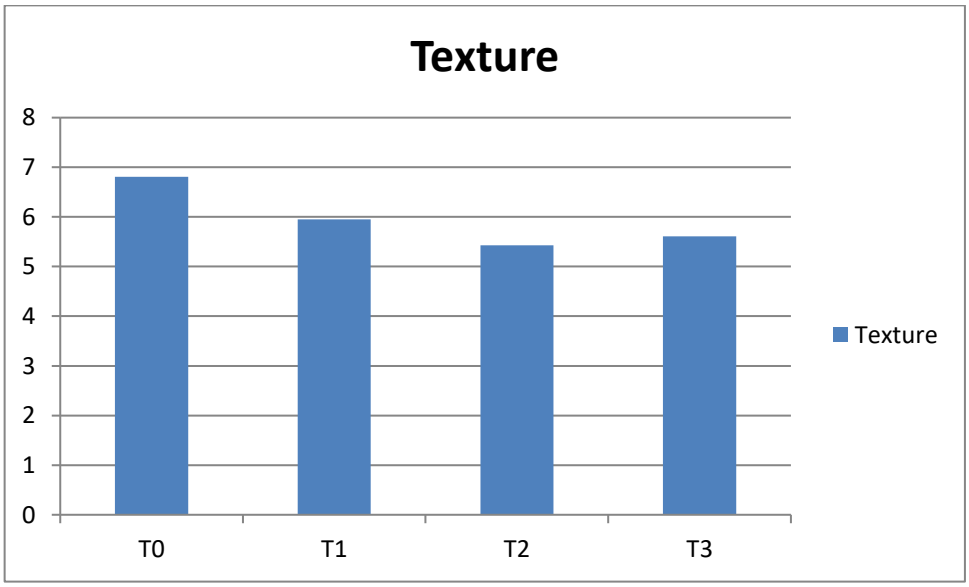

Figure 3.9: Graph of Mean ± SD of *Momordica charantia* powder and wheat flour supplemented chapattis

3. DISCUSSIONS

Most clinical researches have been done on the Saponins extracts of the *Momordica charantia*. It is one of the small organic molecules and polysaccharides that portray as the main bioactive

substances of *Momordica charantia* with its anti-hyperglycemic activities (Najm, 2012). In 2019, Wang *et al*. conducted a comparative study focusing on the antidiabetic properties and potential mechanisms of saponins (SMC) from M. charantia. They compared these effects with those of polysaccharides (PMC) from M. charantia in high-fat diet-induced type 2 diabetic mice. The findings suggested that orally administering SMC, in comparison to PMC, may significantly contribute to weight restoration, reduced fasting blood glucose levels, alleviation of insulin resistance, and an increased proportion of hepatic phosphorylated adenosine monophosphate-activated protein kinase (p-AMPK)/total protein. Another extensive study was done on the saponin extracts of the *Momordica charantia* which had positive results suggesting that *Momordica charantia* Saponins might control the insulin signaling pathways (Jiang *et al*., 2019). Bitter gourd contains active compounds like flavonoids, saponins, tannins, triterpenes, and alkaloids that affect the overall cholesterol level when hypoglycaemic rats were studied. The compounds prevent the synthesis of fat in the body (Hossain et al., 2011). In a specific study, hyperglycemic rats exhibited significant diabetic symptoms, including polydipsia, polyuria, glycosuria, renal hypertrophy, and increased glomerular filtration rate. When administered bitter melon, notable enhancements were observed in these parameters. The effective dose was determined to be 300 mg/kg of whole fruit, resulting in a 31.64% reduction in blood glucose levels and a 27.35% improvement in insulin sensitivity in the hyperglycemic rats (Mahwish *et al*., 2021). A comparative study was done on twenty two uncomplicated type-2 diabetes mellitus patients divided into two groups. Both the groups were being treated with regulated dose of allopathic medicines with group B being additionally treated with 200ml/day of of *Momordica charantia*. The results showed significant improvement in glycemic control with a decrease in both fasting and random blood sugar in group B (Rauniyar *et al*., 2021). Another comparative study was done on the diabetic rats where a fermented *Momordica charantia* juice (FMCJ) was introduced which significantly impacted the effects of hyperglycemia, hyperinsulinemia, hyperlipidemia, and oxidative stress as compared to the non-fermented studied group (Gao *et al*., 2019).

4. LIMITATION AND RECOMMENDAIONS

Momordica charantia didn't have any important result on figure mass. Over all, the greater part of the logical reviews recommends that a standard utilization of *Momordica charantia* absolutely can evade different wellbeing related issues either by its prophylactic or helpful activities. However, the accessibility of concentrated organic product, seed extracts, capsules and tablets, herb/vine powders is limited for which more studies need to be conducted to meet the demands of the market:

- *Momordica charantia* powder ought to be included the in the food formulation to conquer the way of life related issue
- Nutrition instruction and group based projects ought to be led to make
- Awareness among the masses.
- *Momordica charantia* ought to be empowered in the eating routine of helpless sections attributable to its phytochemicals rich profile.
- The detailed healthful profile ought to be examined with the assurance of specific unsaturated fat, amino acid and vitamin.
- Altered sorts of intense gourd ought to likewise be utilized to check their properties.

5. CONCULSION

The research verified the importance of *Momordica charantia* powder in contrast to sugar level and that the bitter gourd is quantitatively great in nitrogen free extract, protein and fiber ratio. The ratio of calcium, iron as well as copper and zinc are greater in amount in bitter gourd as compared to other minerals. *Momordica charantia* ingesting gives positive impacts on blood glucose level. If consumption of *Momordica charantia* becomes a part of a daily diet, there can be a significant decrease in blood glucose and random blood glucose

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