Development and standardization of functional bread fortified with bitter gourd *(Momordica charantia)* powder

ABSTRACT

The study of bread development was carried out at the Department of food technology, Parul University, Vadodara. The present study focuses on the preparation of functional bread incorporation of bitter gourd powder. The process of bread preparation was standardized by varying the concentration of wheat flour and bitter gourd powder. Innovation in bread production and the inclusion of useful ingredients are essential for the development of functional foods. The greatest processed food industry in India is the bread industry, and the nation's production is continually rising. Momordica charantia (Cucurbitaceae) is a tropical shrub with yellow blooms and green foliage. Bitter gourd has antidiabetic ingredients such as charantin, vicine, and polypeptide-p as well as other generic bioactive ingredients like antioxidants. On the basis of Sensory evaluation, sample T5 was selected. It was found that The addition of 8% bitter gourd powder found to be acceptable with sensory parameters. The present investigation was carried out to study the physical and chemical characteristics of bitter gourd bread. The average proximate constituents such as moisture, carbohydrate, protein, fat, fiber, and ash content were determined of bread which is 33 percent, 74.69 percent, 11.92 percent, 5.22 percent, 4.37 percent, and 3.8 percent respectively. The Fourier transform infrared spectroscopy (FT-IR) of bitter gourd powder bread showed the presence of spectra 3261.63 cm^{-1} which represent the O-H group, 2934.40 cm^{-1} are observed which showed C-H group, 1641.04 cm^{-1} represent C=C group and 1077.89 cm^{-1} represents C-O group. Minerals such as calcium, magnesium, iron and zinc of bread were evaluated. The minerals were calcium (16.0mg), iron (9.59mg), magnesium (14.81mg) and zinc (3.23mg) respectively. The obtained results revealed that the prepared bread sample was good source of carbohydrate, protein, fiber and fat. The selected sample was found to be good source of minerals such as calcium, iron, Zinc and magnesium. Total energy obtained in bitter gourd powder-based bread was 242.82 Kcal/ 100gm. TPC (Total plate count) 7400 cfu/g was observed at refrigeration temperature after 7 days. Bitter gourd powder-based bread was packed in, polyethylene pouches (PEP), and stored under ambient (18-38 ^{o}C) and refrigerated (4-7 ^{o}C) temperature conditions for 7 days and it was observed that the overall increase in moisture content at the ambient temperature of wheat and bitter gourd powder bread ranged from 33.00 to 33.57 percent whereas, the overall decrease in protein and fat ranged from 11.92 to 11.52 percent and 5.22 to 4.65 percent, respectively. The overall increase in moisture content at refrigeration temperature of wheat and bitter gourd powder bread ranged from 33.00 to 33.24 percent whereas, the overall decrease in protein and fat ranged from 11.92 to 11.74 percent and 5.22 to 4.82 percent, respectively. The Moisture increases more at ambient temperature as compared to refrigeration

temperature. Whereas the overall decrease in protein and fat is more in ambient temperature compare to refrigeration temperature. So, refrigeration temperature is more effective for storage than ambient temperature Hence it is finally concluded that prepared product having the good nutritional profile. Utilization of bitter gourd powder for the development bakery food product helps to enhance the nutritional content and health benefits. This type of product development technology helps to improve the market and statistics of bakery industries. The objective of the current study is to improve the health benefits of a traditional bread recipe by including bitter gourd. As a result, it is intended to make bread using a food-based approach and bitter gourd power.

Keywords- Bitter Gourd, FT-IR, antidiabetic, functional bread, Total plate count

1. INTRODUCTION

The food industry is one of the most significant industries since it is in charge of processing agricultural raw materials and providing food (Bigliardi and Galati, 2013). Bakery goods are important processed food enterprises in the globe, with a vast range of products, making it the food industry's largest subzone. A huge increase in global bakery output over the previous decade has resulted in the production of much more biscuits, cakes, muffins, wafers, and other bakery items. (Lassoued *et al*., 2008). The popularity of bread in society is rising, and sales in the bakery sector have been seen to be steadily rising. Innovation in bread production and the inclusion of useful ingredients are essential for the development of functional foods. The greatest processed food industry in India is the bread industry, and the nation's production is continually rising. The two most popular bakery items are bread and biscuits, which make up around (82%) of overall sales (Somayeh *et al*., 2012). Wheat flour, one of the most widely eaten grains on the globe, is primarily used to make bread. It has few beneficial elements but is heavy in fat and carbohydrates. Bread supplementation to improve its physical and nutritional qualities has grown more common and sought as living standards and health awareness has increased (Naifu *et al*., 2019). Ingredients that are frequently used include flour, salt, oil, and leavening agents like yeast. Freshly made bread is widely prized for its flavor, fragrance, quality, and texture. Bread made from refined wheat flour is extensively consumed worldwide, especially by people in developing countries. One of the most intriguing breakthroughs is the creation of novel functional meals (Lodhi *et al*., 2011).

Consuming bitter gourds in a variety of forms, including whole fruit, juice, extract, and dry powder, has been demonstrated in several trials to help lower blood glucose levels (Basch *et al*., 2003 Lawrence *et al*., 2009). It has hypoglycemic characteristics due to the presence of glycosides, saponins, alkaloids, triterpenes, polysaccharides, proteins, steroids, momordin Ic, charantin, a polypeptide-p, and oleanolic acid 3-O-monodesmoside and oleanolic acid 3-O-glucuronide (Ali *et al*., 1993). In comparison to non-insulin-dependent diabetic mellitus rats, insulin-dependent diabetes mellitus rats and normal rats had a significant hypoglycemic effect in fasting and post-prandial stages after drinking the saponin-free methanolic extract of bitter gourd juice. Bitter gourd improves glucose tolerance, lowers postprandial hyperglycemia, and increases insulin sensitivity and lipolysis in rats (Uebanso *et al*., 2007 and Leung *et al*., 2009). Bitter gourd contains a substantial quantity of protein, minerals, vitamins, and polysaccharides and are very nutrient-dense (Aziz et al., 2011). Many diabetes people consume bitter gourd juice in the morning as a natural cure since it has been demonstrated to have hypoglycemic action (Sitasawad *et al.*, 2000). Diabetes mellitus (DM) is a condition of excessively high blood sugar levels or hyperglycemia that is often brought on by a combination of inherited and environmental factors (Leu and Zonszein, 2010). A serious issue with world health is diabetes mellitus. Concern is being expressed throughout the world because of the increase in prevalence from 171 million in 2000 to 366 million in 2030 (Shaw *et al*., 2010). Freeze-dried gourd flesh was rich in lysine compared to soy protein isolate. Arginine and glutamic acid levels in the flesh were not particularly high. Threonine, valine, methionine, isoleucine, leucine, and phenylalanine are essential amino acids that are present in amounts similar to those of soy and other legume proteins (Islam *et al*., 2005). Fresh bitter gourd is a good source of vitamin C (100 g of raw pod offers 84 mg or around 140 percent of RDA) (100 g of raw pod provides 84 mg or about 140 percent of RDA). Vitamin C, one of the greatest natural antioxidants, supports the body in scavenging detrimental free radicals. The vitamin C concentration of bitter gourd is its main nutritional advantage (Balasubramanian *et al*., 2007).

Bitter gourd is a rich source of health-beneficial flavonoids such as ß-carotene, α-carotene, lutein, and zeaxanthin It also includes a significant quantity of vitamin A, which serves as a protective scavenger against reactive oxygen species (ROS) and oxygen-derived free radicals, both of which contribute to aging, cancer, and other disease processes Although if the nutritional value of minerals in one cup of bitter melon is not nearly as great as that of vitamins, it still has some nutritious value. The most prevalent mineral is found in potassium, with 275 mg or 8 percent of the daily value. According to the University of Maryland Medical Centre, potassium is important for the efficient functioning of the cardiac muscle, electrical impulses, muscular contractions, cells, tissues, and digestive system (Sathishsekar, 2005). According to research from the University of California at San Francisco, just about half of American people consume the 25–30 mg of fiber per day that is advised. One cup of bitter gourd has 2.6 g of fiber, which is around 10 percent of the daily requirement. Even if the amount of fiber may appear to be negligible in comparison to the vitamin and mineral content (Jiratchariyakul *et al.*, 2001). M. charantia leaf extracts (methanol and ethanol) have shown a wide range of antibacterial activity in both clinical and experimental settings (Braca *et al*., 2008).

There are some toxic effects of bitter gourd in health such as bitter gourd has been shown to reduce blood glucose levels. The proposed mechanisms include insulin-like actions, stimulation of pancreatic insulin secretion, reduction of hepatic gluconeogenesis, enhanced hepatic glycogen synthesis, and improved peripheral glucose oxidation (Lancet, 2000). After drinking bitter gourd tea, two cases of hypoglycemic coma and convulsions in youngsters were observed (Jayasoorya *et al*., 2000), A poisonous lectin found in bitter gourd seeds and outer rind prevents the gut wall from producing proteins. Yet, there is no correlation between this with clinical symptoms or indications in people (Sultana and Bari, 2003), After consuming bitter melon seeds, those who lack the enzyme glucose-6-phosphate dehydrogenase run the risk of developing favism (Semiz and Sen 2007), Animals that were given bitter gourd fruit juice and seed extract orally showed significant increases in y-glutamyl transferase and alkaline phosphatase (Semiz and Sen 2007). Bitter gourd overconsumption may result in a moderate stomach ache or diarrhea. If diabetics regularly drink bitter gourd while taking hypoglycemic medications, they will need to change the dosage of their medications. Bitter gourd or its juice should not be consumed in excess by pregnant women as it may stimulate the uterus and cause uterine tightness and premature labor. (Leu and Zonszein, 2010). The bitter gourd has a lot of the two features emmenagogue and an abortifacient. Those who suffer from ulcers and heartburn should avoid drinking bitter gourd tea since it might make their symptoms worse (Sultana and Bari, 2003) and According to Panda and Kar (2000), while T3 was increased by an alcoholic extract of *Momordica charantia* fruits, T4 was decreased. *M. Charantia* fruit extract, when taken in excess, may show to be hazardous with regard to thyroid function and lipid peroxidation since two higher dosages suppressed thyroid hormone concentrations and increased hepatic lipid peroxidation.

Wheat is a valuable source of natural antioxidants and dietary fibre (Nidhi *et al*., 2021). The temperate region's main crop, wheat, is farmed from 67^{o} N in Scandinavia and Russia to 45^{o} S in Argentina (Feldman, 1995). Gluten is the primary wheat protein responsible for the ability of wheat flour to make a dough and is the secret of wheat's exceptional capacity to fit the manufacturing of leavened goods. According to their role in the wheat grain, the proteins that makeup gluten are storage proteins (Shewry, 1999). The protein residue left behind when separating maize starch is known as gluten in the commercial world (Patil, 2003 and Patil, 2004).

In this research, FT-IR is used for the analysis of the functional properties of the product. Fourier Transform Infrared Spectroscopy (FT-IR) light is absorbed by the vibrational motion of the molecule in infrared (IR) absorption spectroscopy, a kind of vibrational spectroscopy. Without the need for separate scanning, quick and high-resolution spectra are acquired for each wavelength. The results of even tiny samples can be obtained quickly. Food engineering uses a variety of scientific disciplines for tasks such microbial cell identification, macromolecule structural analysis, qualitative and quantitative analysis of organic materials, structural identification, stereochemistry structure determination, and purity control. (Büyüksırıt and Kuleaşan, 2014).

So, these studies were carried out to develop Bitter gourd powder-based bread.

2. Material and methods

The present investigation entitled **"Development and standardization of functional bread fortified with bitter gourd *(Momordica charantia)* powder"** was conducted under different experiments in the Department of Food Technology, Parul Institute of Applied Sciences, Parul University, Vadodara, Gujarat, India

2.1. Procurement of raw materials

Wheat flour was purchased from the local market of Vadodara. The wheat flour was collected randomly and brought to the laboratory for carrying out the present study. Bitter gourd powder was developed in the laboratory by using a mechanical cabinet air dryer. The other ingredients were purchased at the Vadodara local market, including Salt, Yeast, oil, and plastic pouches, containers whereas other materials such as utensils, weighing balance, etc.

2.2. Experiment details

The present research was focused on the Development of sugar-free bitter gourd powder-based bread. The whole investigation was divided into various experiments and sub-experiments. The experiment details are given below:

2.2.1. Preparation of bread

Wheat flour, bitter gourd powders, oil, salt, yeast, and water were the different ingredients used for the preparation of bread. Different combinations of the ingredients were tried. Yeast was added to lukewarm water and kept it 10 min for activation. After that the flour, vegetable powder and salt mix properly. The activated yeast was added to flour and flour was kneaded into dough with fat and the required amount of water. Further, the dough was kept for 1 h. Kneading was done again followed by fermentation for 2 h. The dough was further added to a container and proofing was done for 30 min. It was baked in a pre-heated oven at 150^0C for 30 min.

2.2.2. Packaging and storage

The best treatment/ combination was selected by the sensory evaluation for further studies. The best treatment from the blend was selected and further packed in polyethylene pouches (0.75 mm gauge) and stored at refrigerated and ambient conditions. The bread was analyzed for various physicochemical and sensory parameters at different intervals of 0, 3, 5and 7 days of storage.

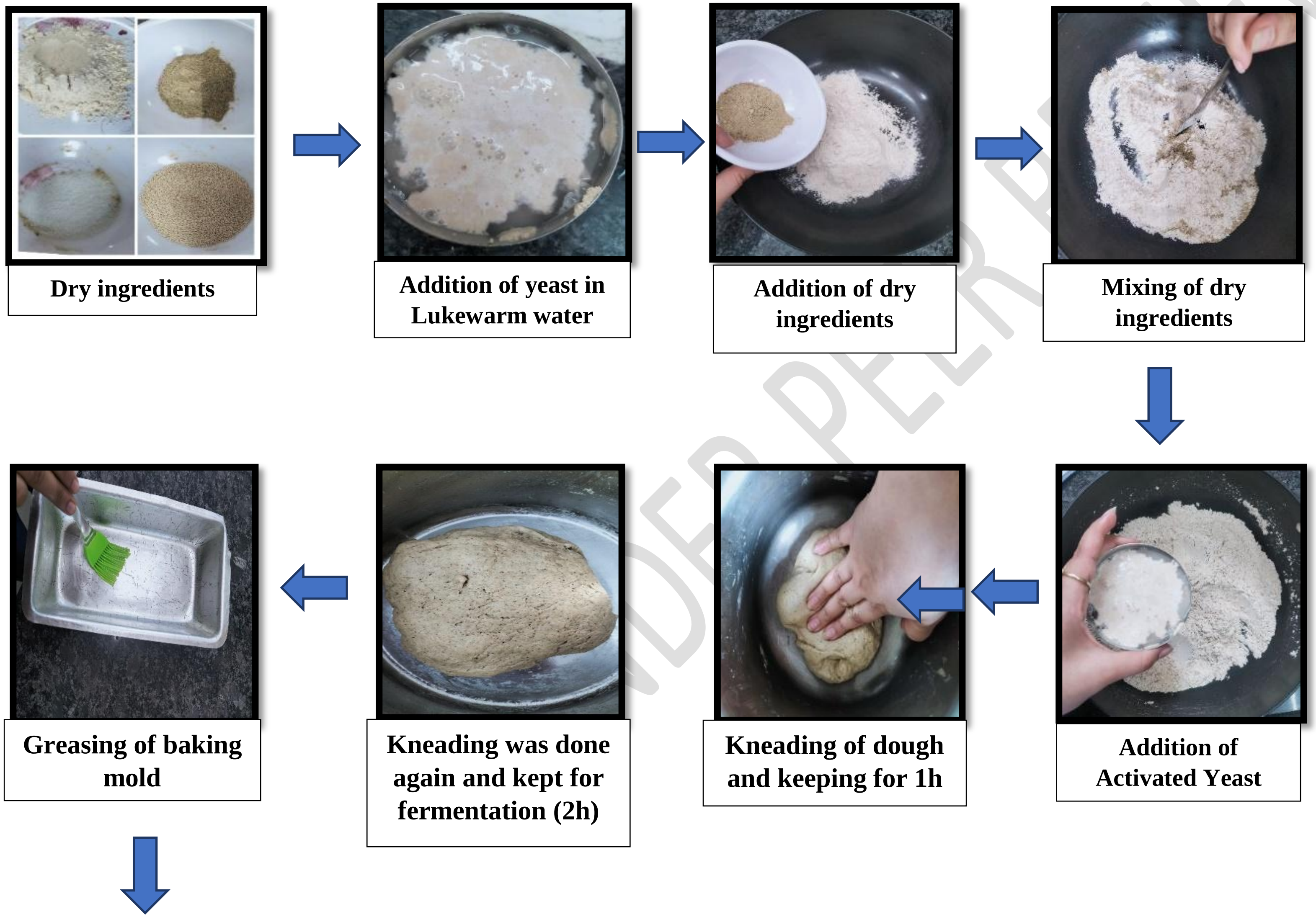
Dry ingredients
Addition of yeast in Lukewarm water
Addition of dry ingredients
Mixing of dry ingredients
Addition of Activated Yeast
Kneading of dough and keeping for 1h
Kneading was done again and kept for fermentation (2h)
Greasing of baking mold

Figure 1 Unit operation for development of sugar free Bitter gourd powder Bread

2.3. Standardization of proportion of blends

Table 1 reflects the proportion of bitter gourd powder were used for development of functional bread. The blends were standardized on the basis of sensory evaluation of 9-point Hedonic rating scale.

Table 1 Standardization of proportion of blends (Wheat flour and bitter gourd powder)

Treatments	Wheat flour (gm)	Bitter gourd powder (gm)	Yeast (gm)	Salt (gm)	Oil (ml)
T_0	100	-	10	5	10
T_1	98	2	10	5	10
T_2	96	4	10	5	10
T_3	95	5	10	5	10
T_4	93	7	10	5	10
T_5	**92**	**8**	**10**	**5**	**10**
T_6	90	10	10	5	10
T_7	88	12	10	5	10
T_8	87	13	10	5	10
T_9	86	14	10	5	10
T_{10}	85	15	10	5	10
T_{11}	84	16	10	5	10
T_{12}	82	18	10	5	10
T_{13}	80	20	10	5	10
T_{14}	78	22	10	5	10
T_{15}	76	24	10	5	10
T_{16}	75	25	10	5	10
T_{17}	74	26	10	5	10
T_{18}	72	28	10	5	10
T_{19}	71	29	10	5	10
T_{20}	70	30	10	5	10

2.4. Chemical, functional and sensory analysis

Moisture, Ash, Fiber, Total plate count and carbohydrate were determined as per the method explained by Ranganna. (2009). Protein and fat were determined according to the procedure mentioned in AOAC (2012). The energy value is measured by bomb calorimeter as a procedure mentioned in Phillipson (1964). Mineral content was determined by Rajsekaran *et al*. (2005). Fourier Transform-Infrared Spectroscopy was determined as per method of Stuart (2005). Nine-point hedonic scale for sensory evaluation were determined as per method explained by Amerine *et al*. (1965).

3. Result and Discussion

The present investigation entitled **"Development and standardization of functional bread fortified with bitter gourd *(Momordica charantia)* powder"** was conducted under different experiments in the Department of Food Technology, Parul Institute of Applied Sciences, Parul University, Vadodara, Gujarat, India during the years 2021-2022. The results of the study are presented and discussed under different heads and sub-heads:

3.1. Standard formulation used for the preparation of bread

Table 2 indicated the standardized blends of bitter gourd powder and wheat flour selected for the development of bread on the basis of sensory evaluation (9-point Hedonic rating scale) for further study. Out of 20 treatments, the panel of judges—faculty members, including the dean—and post-graduate students from the department of food technology chose T5 as the best one.

Table 2 Standard formulation used for the preparation of bread

Ingredients	Composition (g)
Wheat flour	92
Bitter gourd powder	8
Fat (Refined oil)	10
Salt	5
Yeast	10

3.2. Chemical and functional properties of bread

The trials were conducted for the analysis of bitter gourd powder- based bread., moisture percent, protein percent, carbohydrate percent, fibre percent, ash percent, Fat percent, energy value Kcal, FTIR analysis, Ca percent, Mg percent, Fe mg/ 100 g and Zn mg/ 100 g. These all analysis are done for bitter gourd powder-based bread at both ambient and refrigeration temperature.

3.2.1. Chemical analysis

The data presented in Table 3 and Table 4 showed the proximate composition and mineral composition of bitter gourd powder-based bread respectively and the physico-chemical parameters of bread is presented and discussed under the following heads and sub-heads

Table 3 Proximate composition of bread

S.no.	**Parameters**	**Amount (%)**
1	Protein	11.92
2	Fat	5.22
3	Fiber	4.37
4	Carbohydrate	74.69
5	Moisture	33
6	Ash	3.8
7	Energy value	242.82 Kcal/100gm

Table 3 represented bitter gourd powder-based bread had 11.92 percent protein, 5.22 percent fat, 4.37 percent fibre, 74.69 percent carbohydrate, 33 percent moisture, 3.8 percent ash and Total energy obtained was 242.82 Kcal/ 100gm respectively. Gangakhedkar *et al.*, (2021) who reported similar range of proximate composition of bitter gourd powder-based bread.

Table 4 Mineral composition of bread

S.no	**Minerals**	**Amount (mg/100gm)**
1	Ca	16.0
2	Fe	9.59
3	Zn	3.23
4	Mg	14.81

The obtained data from Table 4 for mineral composition revealed that the bitter gourd powder-based bread was a good source of minerals. It was found the mineral composition of the bread sample was calcium (16.0mg), magnesium (14.81mg), iron (9.59mg), and zinc (3.23mg) respectively. Gangakhedkar *et al.*, (2021) reported a similar range of mineral composition of bitter gourd powder-based bread.

3.2.2. Functional analysis

3.2.2.1 Fourier Transform – Infrared Spectroscopy (FT-IR) analysis

Fourier Transform Infrared spectroscopy (FT-IR) is a spectral Measurement method with long-wave infrared radiation that records absorbance in a time field and converts it to a frequency field using the Fourier transform algorithm. FTIR has been used to analyse a variety of samples due to its ability to identify functional groups of chemical compounds, such as carbohydrates, esters, as well as the chemical bonds between atoms.

The results obtained in figure 2 Shows FT-IR spectra 3261.63 cm^{-1} which represent O-H group, 2934.40 cm^{-1} are observed which showed C-H group, 1641.04 cm^{-1} represent C=C group and 1077.89 cm^{-1} represent C-O group in the bitter gourd powder-based bread. Similar observation has been recorded by Torkamani *et al*., (2018) and Khan *et al*., (2019).

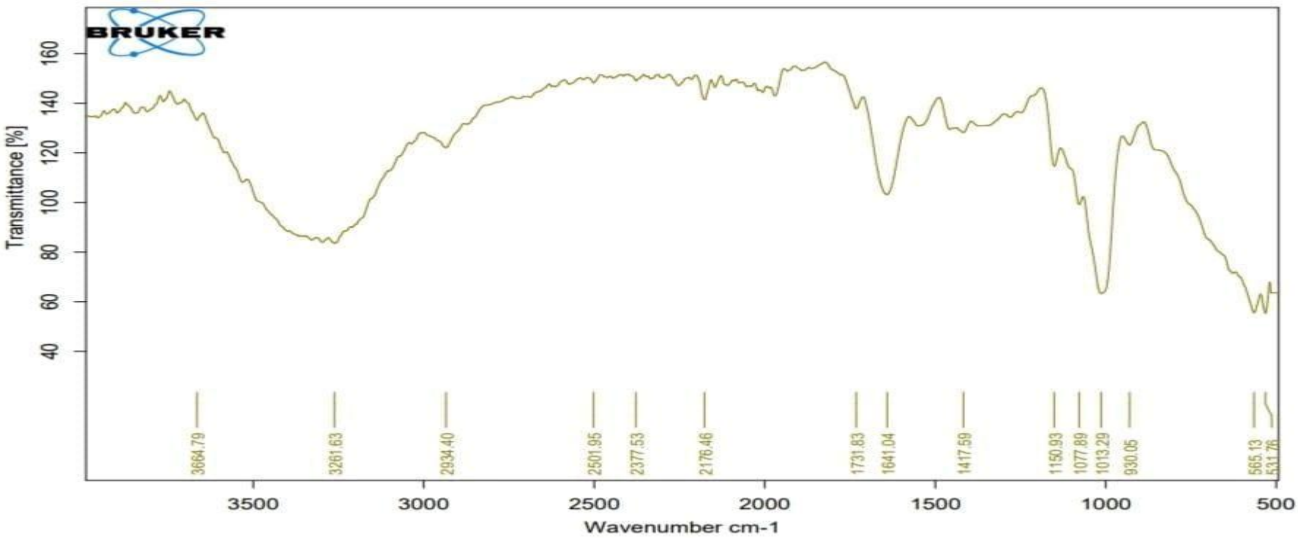

Figure 2 FT-IR analysis peaks of bitter gourd powder-based bread

3.3. Quality evaluation of bitter gourd powder-based bread during storage

3.3.1. Storage study of bitter gourd powder-based bread at ambient temperature and refrigeration temperature

The developed bread was packed in polyethylene and stored under refrigeration conditions (4 ^{0}C) and ambient conditions (18-38 ^{0}C). Bread could be stored only for 7 days and is evaluated for its nutritional quality during storage. The bread was analyzed for various chemical and sensory parameters at different interval of 0, 3, 5and 7 days of storage.

Table 5 Storage study at ambient temperature (%)

S.No.	0 Day	3 Days	5 Days	7 Days
Moisture	33.00	33.12	33.45	33.57
Protein	11.92	11.82	11.64	11.52
Fat	5.22	5.07	4.84	4.65

Table 6 Storage study at refrigeration temperature (%)

S.No.	0 Day	3 Days	5 Days	7 Days
Moisture	33.00	33.05	33.14	33.24
Protein	11.92	11.82	11.80	11.74
Fat	5.22	5.12	4.94	4.82

3.3.1.1. Moisture (%)

The data presented in Table 5 and Table 6 ambient and refrigeration temperature respectively elucidated that there was overall increase in moisture content of bitter gourd powder-based bread. There was a non-significant storage condition on moisture content of the bread during storage. The bread stored in ambient condition had higher increase from 33.00 to 33.57 percent than that the stored at refrigerated condition from 33.00 to 33.24 percent. The hygroscopic nature of bread likely contributed to the increase in moisture content during storage. Jood *et al*. (2016) found almost identical results.

3.3.1.2 Protein (%)

The data appended in Table 5 and Table 6 reflects the effect of storage on the protein content of bread at both ambient and refrigeration temperatures respectively which indicates that there was an overall decrease in the protein content of bread during a storage period of 7 days. There was a non-significant effect of storage condition on the protein content of the bread during storage. The bread stored in ambient condition had a higher decrease from 11.92 to 11.52 percent than in refrigerated condition from 11.92 to 11.74 percent. Protein loss during storage could be due to the hydrolysis of peptide bonds by protease enzymes, which causes protein molecules to divide. The findings are consistent with those of Wani and Sood (2014).

3.3.1.3 Fat (%)

The critical observation of the data in Table 5 and Table 6 indicated that there was an overall decrease in fat content in both ambient and refrigeration temperature respectively during storage period of 7 days. There was non-significant effect of storage condition on the fat content of the bread during storage. The bread stored at ambient condition had higher decrees from 5.22 to 4.65 percent fat content than that of stored in refrigerated condition from 5.22 to 4.82 percent of fat content. The loss of fat content in bread could be due to triglyceride hydrolysis during storage. The findings are similar to those of Masih *et al*. (2014) and Divyashree *et al*. (2016)

3.4. Microbial Examination of Bitter gourd powder-based bread

Total Plate Count of bitter gourd powder-based was observed 7400cfu/g at refrigeration temperature after 7 days of storage. Based on this observation, it was concluded that the bread is microbiologically recommended to consume up to 7th days at refrigeration temperature.

3.4. Cost of production of bitter gourd powder-based bread

Table 7 Cost of production of bitter gourd powder-based bread

S.No.	Particular	Rate Rs.	Rate Rs.	Quantity	Amount Rs.
1	Wheat Flour	45/kg	4.5/100gm	92gm	4.14
2	Bitter gourd powder	33.28/kg	3.3/100gm	8 gm	0.264
3	Yeast	1000/kg	100/100gm	10gm	10
4	Salt	20/kg	2/100gm	5gm	0.1
5	Oil	140/kg	14/100gm	10gm	1.4
6	Packaging Material	0.5/pouch	0.5	1 pouch	0.5
7	Processing cost	@ 10% of total cost	-	-	1.64
8	Total Cost (100gm)	-	-	-	**18.04**

The cost incurred in preparation of bitter gourd powder-based bread was calculated by taking into consideration the cost of all inputs. The processing cost and other expenses including depreciation are added to the total expenditure. The sale price per 100 g of the products was calculated after adding 10 percent processing cost. The cost of bitter gourd powder was calculated manually in lab as per there raw materials. The data represented in Table 7 for bitter gourd powder-based bread. The cost of bread is 18.04 /100 gm.

Conclusion

The research investigation entitled **"Development and standardization of functional bread fortified with bitter gourd *(Momordica charantia)* powder"** was carried out in the Department of Food Technology, Parul Institute of Applied Sciences, Parul University, Vadodara, Gujarat, India during 2021-2022. To accomplish the study's goal, a series of painstakingly performed experiments were standardized and performed in order. The findings of the present investigation have been succinctly stated and concluded as follows:

The developed bread is packed in polyethylene and stored under refrigeration conditions (4 ^{0}C) and ambient conditions (18-38 ^{0}C. Bread could be stored only for 7 days and is evaluated for its nutritional quality during storage. The overall increase in moisture content at ambient temperature of wheat and bitter gourd powder bread ranged from 33.00 to 33.57 percent whereas, the overall decrease in protein and fat ranged from 11.92 to 11.52 percent and 5.22 to 4.65 percent, respectively. The overall increase in moisture content at refrigeration temperature of wheat and bitter gourd powder bread ranged from 33.00 to 33.24 percent whereas, the overall decrease in protein and fat ranged from 11.92 to 11.74 percent and 5.22 to 4.82 percent, respectively. The Moisture increases more at ambient temperature as compared to refrigeration temperature. Whereas the overall decrease in protein and fat is more in ambient temperature compare to refrigeration temperature. During the FT-IR analysis we observed spectra 3261.63 cm^{-1} which represent O-H group, 2934.40 cm^{-1} was observed which showed C-H group, 1641.04 cm^{-1} represent C=C group and 1077.89 cm^{-1} represent C-O group in the bitter gourd powder-based bread. Total Plate Count of bitter gourd powder-based was observed 7400cfu/g at refrigeration temperature after 7 days of storage. Based on this observation, it was concluded that the bread is microbiologically recommended to consume up to 7th days at refrigeration temperature. The cost incurred in preparation of bitter gourd powder-based bread was calculated by taking into consideration the cost of all inputs. The processing cost and other expenses including depreciation are added to the total expenditure. The sale price per 100 g of the products was calculated after adding 10 percent processing cost. The cost of bread is 18.04 /100 gm was calculated.

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