The Bioscan
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
20(2): S2: 824-828, 2025 www.thebioscan.com

FORMULATION OF FIBER RICH TORTILLA CHIPS (SNACK) USING PSYLLIUM HUSK

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DOI: 10.63001/tbs.2025.v20.i02.S2.pp824-828

KEYWORDS
Tortilla Chips, Corn, Ragi, Psyllium husk

Received on:

12-04-2025

Accepted on:

15-05-2025

Published on:

21-06-2025

ABSTRACT

Snacks are a convenient substitute for traditional meals. Corn flour is the traditional ingredient used to make tortilla chips. The high calcium, iron, and dietary fiber content of Ragi makes it stand out. The utilization of Psyllium husk in various cultures has been traditional for its medicinal purposes. A rise in the consumption of healthy foods is necessary to lower the risks of chronic diseases. The aim of this research was to create a snack product that is rich in fiber. The objective of this research was to develop a tortilla chip that has a high amount of nutrients by incorporating Psyllium husk. The experiment involved making tortilla chips by substituting corn flour with Psyllium husk in different proportions. After preparing Tortilla chips, the sensory quality was assessed. In this investigation, attempts have been made to develop fried snacks from corn, ragi, psyllium husk, red chili powder, salt, and turmeric etc. Tortilla chips were prepared using the methodology provided by Bage V. R. *et al,* (2023). Two steps were involved in the preparation process: masa flour preparation and tortilla chip preparation. Tortilla Chips were deep-fat fried by using cottonseed oil at 180°C for 2-3 min in a fryer. The sensory analysis led to the formulation of a composite flour that contains corn and ragi in an 80:20 ratio to supplement tortilla chips. The inclusion of Psyllium husk (3%) resulted in the addition of nutritional value and improved the quality of tortilla chips. Thus, the study succeeded in creating fiber-rich tortilla chips that have a good nutritional profile. Nutritionally and health-wise, the developed product was superior to standard tortilla chips. The future market would be greatly influenced by fiber-rich tortilla chips.

INTRODUCTION

Snack foods are essential in our daily lives, serving as a source of pleasure and relaxation. Snack foods are essential in our daily lives, serving as a source of pleasure and relaxation. These are a convenient alternative to traditional meals because they are affordable and can be found in different types (Vinothini *et al*, 2015). The popularity of snacks that are healthy, convenient, and low in calories and fat has grown. The demand for tortilla chips has risen in movie theatres and sports venues compared to other snacks. In 2023, the tortilla chip market worldwide was valued at USD 27.3 billion and is expected to grow at a CAGR of 8.8% between 2024 and 2030 (https://www.grandviewresearch.com/industry-analysis/tortilla-chips-market). Corn is a good source of nutrition, including dietary fiber and minerals that are required by the body. It is also referred to as maize (Rosalinda *et al*, 2025; Bage V. R. *et al*, 2022). In India, finger millet (Eleusine coracana) is a significant millet crop. Ragi is another name for it. The nutritional value of ragi is well-recognized due to its high levels of minerals, dietary fiber, and phenolic compounds (Jamale *et al*, 2022; Goswami *et al*, 2017). The medicinal properties of Psyllium husk have been used in various cultures for centuries. Psyllium husk contains dietary fibers that are beneficial for human health, both in preventing and treating chronic diseases Geremew Kassa, *et al*, 2024; Franco, *et al*, 2020; Verma and Mogra, 2013; Singh, B., 2007).

Turmeric (*Curcuma longa* L.) is widely recognized as a medicinal herb. Curcumin is present in it and has a yellow hue. It is commonly acknowledged as a condiment that adds color and flavor to food. It has multiple benefits for the gastrointestinal tract of humans (Nguyen *et al*, 2024; Nasri *et al*, 2014; Ammon *et al*, 1992). The color and pungency of red chili powder are the most significant qualities. The red color of chili is primarily caused by carotenoid pigments (Mamun *et al*, 2016).

Fried chips are the snack food that is most common and popular in India. Corn snack products like tortilla chips are made through the nixtamalization process. The nixtamalization process involves alkali cooking, steeping, washing, and grinding of the kernels to produce corn masa. This process aids in softening the pericarp, endosperm, and gelatinizing the starch (Bage Vaibhav R., *et al*, 2023; Dasaur, 2001). The triangular-shaped tortilla mass is fried in vegetable oil after being kneaded and molded. Instant energy is provided by these snack chips because they are a good source of nutrients. The development of fiber-rich foods has been fueled by the growing interest in the connection between health, diet, and food products (Kaur, S., and Aggarwal, P., 2017; Kawas, M. L., and Moreira, R. G., 2001; Moreira *et al*, 1997). The development of tortilla chips in the present investigation was motivated by the goal of improving their nutritional profile by incorporating psyllium husk.

2. MATERIALS AND METHODS

Psyllium Husk powder was procured from a medical mall in Kolhapur, Maharashtra, 416008. Food-grade lime was procured from an authentic chemical supplier in Shahupuri, Kolhapur, Maharashtra, 416001. The other ingredients, including corn, ragi, cottonseed oil, baker's shortening, chili powder, salt, turmeric, and mineral water, were obtained from a local grocery store of Uchgaon, 416005. The nutritional properties (chemical composition) of the raw materials and the product (fiber-rich tortilla chips) were accessed in the laboratory of Food Technology Program, Department of Technology, Shivaji University, Vidyanagar, Kolhapur, Maharashtra, India, 416004. The official methods of A.O.A.C. were used for determining moisture, protein, crude fiber, fat, ash, carbohydrate, and energy (El-Shayeb *et al*, 2018).

PREPARATION OF TORTILLA CHIPS

Tortilla chips were prepared with some minor adjustments according to the methods provided by Bage, V. R. *et al.* (2023), Chhabra *et al*, (2017), and Quintero-Fuentes *et al*, (1999). Two steps were involved in the preparation process: preparing masa flour and making tortilla chips.

Masa flour preparation

For 40 minutes, the finger millet/ragi (400 g) was cooked with 1 liter of water and 2 grams of lime. For one hour, corn (500g) was cooked with 1 liter of water and 6 g of lime. Then, the cooked grains were steeped in water at 25±2℃ for 24 hours, then washed and finely ground. The drying process of these ground materials took place in an oven at 60℃. In the end, grain flours were made by grinding in a pulverizer (figure 1 and figure 2).

Tortilla chip preparation

The masa flour (100 g) from each formulation (Table 1) was mixed together with baker's shortening (10 g), salt (2.5 g), chili powder (2 g), and turmeric (1g), among other ingredients. Soft dough masa was produced by using the right amount of mineral water and kneading it uniformly. For 15-20 minutes, Masa was permitted to rest on a wet cotton cloth. A manual tortilla press was used to press and shape dough balls made of 30 grams of masa into flat discs that are 0.1 cm thick. For 3 minutes, the dough discs were baked at 220℃. In order to balance the moisture content of the baked chips, a 15-minute packaging period was given. Using a round cutter, the masa discs were manually cut in both transverse directions after being placed on plastic trays. Tortilla Chips were deep-fat fried by using cottonseed oil at 180℃ for 2-3 min in a fryer (figure 3 and figure 4) (Bage, Vaibhav R, *et al*, 2023; Chhabra, N., *et al*, 2017; Quintero-Fuentes *et al*, 1999).

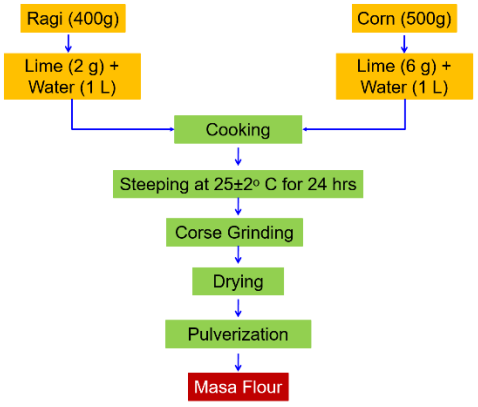

Figure 1: Flow chart of Masa flour preparation

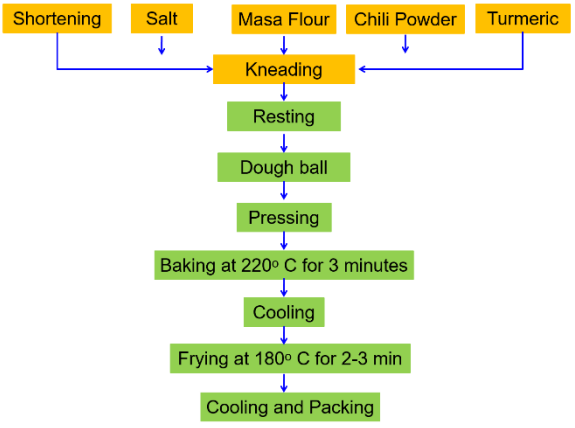

Figure 3: Flow Chart Tortilla chips (Snack) preparation

Figure 2: Psyllium Husk

Figure 4: Tortilla Disc

Sensory analysis

Fiber-rich tortilla chips (snacks) were evaluated on a 9-point hedonic scale by a panel of 20 semi-trained judges. Sensory evaluation includes the use of appearance, color, aroma, texture, and overall acceptability. Sensory analysis was used to select the most acceptable formulation for further study (Bage, Vaibhav R, *et al*, 2023; Chhabra, N., *et al*, 2017; Larmond, E., 1970).

Incorporation of psyllium husk in composite flour

Tortilla chips prepared with the substitution of composite flour with psyllium husk. The chosen formulation included Psyllium husk at levels of 1, 2, 3, 4, and 5%. Sensory parameters were used to evaluate fiber-rich tortilla chips. Table 1 displays the trials used to formulate tortilla chips using corn and ragi masa flour.

Table 1: Tortilla chips formulation using corn and ragi masa flour

Formulation	Corn (g)	Finger Millet/ Ragi (g)	Baker's shortening(g)	Salt(g)	Chili Powder(g)	Turmeric(g)
S1	100	0	10	2.5	2	2
S2	95	5	10	2.5	2	2

S3	90	10	10	2.5	2	2
S4	85	15	10	2.5	2	2
S5	**80**	**20**	**10**	**2.5**	**2**	**2**
S6	75	25	10	2.5	2	2
S7	70	30	10	2.5	2	2

3. RESULTS AND DISCUSSION

Chemical Composition

Corn, ragi, and Psyllium husk were found to have respective moisture contents of 7.9±0.1g, 13±0.05g, and 7±0.06g per 100 grams. The highest value of crude fiber was found in Psyllium husk among the raw materials. The nutritional profile of the psyllium husk corn was within the range as reported by Anitha, S., and Ramya, H. N. (2020). Corn and ragi were excellent carbohydrate sources. Also, corn and ragi were found to be a top-notch source of protein. The nutritional value of tortilla chips would be significantly enhanced in terms of crude fiber with the addition of psyllium husk.

The nutritional composition of ragi was in accordance with the range reported by Bage *et al.*, 2023 and Gull *et al.*, 2014. The nutritional profile of the corn was within the range as reported by Madan, *et al*, (2021). Table 2 shows the chemical makeup of the raw materials and final product.

Table 2: Chemical composition of raw materials and final product

Parameters	Corn	Ragi	Psyllium husk	Fiber Rich Tortilla Chips (Snacks)
Moisture (%)	7.9±0.1	13±0.05	7±0.06	1.8±0.02
Protein (%)	9±0.2	7.4±0.3	1.5±0.2	8±0.3
Fat (%)	4.8±0.02	1.4±0.03	Nil	24±0.02
Crude Fiber (%)	1.2±0.1	3.6±0.2	72.±0.02	3.8±0.12
Carbohydrate (%)	76.73±0.81	72.2±0.3	15.65±0.12	62.4±0.06
Ash (%)	1.2±0.08	2.4±0.3	3.85±0.04	1.9±0.02
Energy (Kcal)	386.12±2.92	331±0.12	68.6±0.4	497.6±0.3

(All the given values are Mean±SD of 3 determinations.)

Sensory assessment of tortilla chips prepared from composite flours

The majority of tortilla chips are made with 100% nixtamalized corn flour. Different formulations containing corn and ragi were used to prepare them in this study. From 0-30%, corn masa was replaced with ragi. As previously mentioned in table 1, the masa of the respective grains was made. The optimal mix of tortilla chips S5 (corn: ragi; 80:20) was decided based on sensory acceptability. Table 3 shows the sensory scores of tortilla chips made with composite flours.

Table 3: Sensory scores of tortilla chips prepared from composite flours

Formulation	Color	Flavor	Taste	Texture	Overall Acceptability
S1	7.8±0.8	7.8±0.2	7.8±0.5	7.7±0.1	7.77±0.4
S2	7.9±0.9	7.9±0.3	7.8±0.2	7.7±0.6	7.82±0.5
S3	7.9±0.7	8±0.5	7.9±0.3	7.9±0.5	7.92±0.5
S4	8±0.7	8±0.7	8±0.7	8±0.7	8±0.7
S5	**8.1±0.2**	**8.2±0.2**	**8.2±0.2**	**8.2±0.2**	**8.17±0.2**
S6	8±0.8	8±0.8	7.8±0.8	7.8±0.8	7.9±0.8
S7	7.8±0.4	7.9±0.4	7.9±0.4	7.7±0.4	7.82±0.4

Effect of incorporation of psyllium husk on quality and sensory attributes of tortilla chips

As the concentration of psyllium husk increased, the texture became fibrous (figure 5). Fried Snacks containing 3% psyllium husk were better than the 5%. The fiber-rich snack, which includes 3% psyllium husk, scored higher marks in terms of color, flavor, taste, texture, and overall acceptability. The impact of psyllium husk on the sensory features of tortilla chips positioned on a table 4.

Table 4: Effect of psyllium husk on sensory attributes of tortilla chips

Level %	Color	Flavor	Taste	Texture	Overall Acceptability
Control (S5)	8.1±0.2	8.2±0.2	8.2±0.2	8.2±0.2	8.17±0.2
1	8.2±0.4	8.2±0.3	8.3±0.4	8.3±0.1	8.17±0.3
2	8.2±0.5	8.2±0.5	8.3±0.3	8.3±0.3	8.25±0.4
3	**8.4±0.4**	**8.4±0.4**	**8.5±0.1**	**8.6±0.3**	**8.47±0.3**
4	8.3±0.8	8.1±0.6	8.2±0.6	8.1±0.8	8.17±0.7
5	8.1±0.6	8.1±0.8	8.2±0.4	8±0.8	8.1±0.6

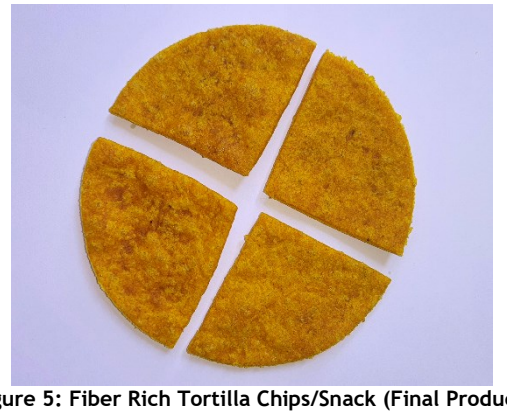

Figure 5: Fiber Rich Tortilla Chips/Snack (Final Product)

CONCLUSION

Snacks such as tortilla chips are a convenient substitute for traditional meals. In this study, attempts have been made to develop fried snacks from corn, ragi, psyllium husk, red chili powder, salt, and turmeric, etc. The inclusion of psyllium husk resulted in the addition of nutritional value and improved the quality of tortilla chips. Thus, the study successfully created fiber-rich tortilla chips with a favorable nutritional profile. Nutritionally and health-wise, the developed product was superior to standard snacks. The future market would be greatly influenced by fiber-rich tortilla chips.

ACKNOWLEDGEMENTS

I want to express my gratitude to Prof. (Dr.) Ajit Subhadra Bhanudas Kolekar (I/C Director) for providing facilities in the Department of Technology, Shivaji University, Kolhapur, Maharashtra, India, 416004.

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