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RESEARCH PAPER
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Development of Biscuits Formulated from Citrus Dietary Fibre

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ABSTRACT

Biscuit development was carried out at Parul Institute of Applied Sciences, Parul University, Vadodara. The main objective was to develop biscuits which can provide enough energy and proteins and can be consumed by celiac patients as well. Treatment and management of food processing waste is a major challenge for food industry. Pomace left over after sweet lime pulp's juice has been extracted is viewed as wastage and isn't appropriately used. While these wastes may be used to create wholesome and nourishing snacks. Biscuits were prepared by using Oats flour, *C. limmettiodes* pomace powder ,sugar, butter and water. These biscuits were then analysed for physico-chemical, microbiological and sensory characteristics. Three different formulations were developed with different concentrations of *C. limettiodes* pomace powder (0%, 5%, 10%) Sample 2 formulation with 5% *C. limettiodes* pomace powder was found to be the best on the basis of sensory evaluation. Selected biscuits were assessed for physico-chemical and microbiological parameters. The selected biscuits were found to have the following compositions: 3.1% Moisture, 5.4 g of protein, 24.8 g Fat, 65.8 g Carbohydrates, 508Kcal Energy, 9.32 g Dietary fibre.

Key Words : Biscuits, *C. limmettiodes*, Citrus, Dietary fibre

INTRODUCTION

In the past ten years, consumers' worries about convenient foods and a healthy diet have grown dramatically. Consumers today care about the quality of their food as well as its nutritional worth and safety. Dietary fibre (DF) is one of the nutritional components that has been shown to significantly improve health (Rosell *et al.*, 2006). DF stands for the portion of fruits, vegetables, grains, nuts, and legumes that humans are unable to digest (Ayadi *et al.*, 2009). Principal DF sources include industrial additions (modified cellulose, modified pectin, commercial gums, and algal polysaccharides) as well as cell wall components (cellulose, hemicellulose, lignin, and pectic substances) and non-structural components (gums and mucilage's) (Grigelmo *et al.*, 1999).

Although numerous fibre sources have long been recognised for their laxative and bulking characteristics, DF is regarded as a physiologically inactive substance (Raghavendra *et al.*, 2006). It has been demonstrated to be crucial in the control and effective management of diabetes mellitus and obesity, as well as in the avoidance of the risks of carcinogenesis and atherosclerosis (Raghavendra *et al.*, 2006).

Fibre-rich by-products can be added to food products as low-cost, non-caloric bulking agents to partially replace wheat, fat, or sugar, as agents to improve emulsion or oxidative stabilities, and as agents to improve water and oil retention (Elleuch *et al.*, 2011). Foods containing fibre can alter the final goods' sensory qualities, rheological behaviour, consistency, and texture (Dhingra *et al.,* 2012).

The demand for bakery goods with more nutritional value, like those fortified with fibre, has grown recently (Gómez *et al.,* 2010). Due to its ability to hold onto water, DF can be added to bakery items to improve DF intake, lower calorie density, extend freshness, and reduce

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economic losses (Gomez *et al.*, 2003).

For the food industry, it is urgently necessary to discover new sources of DF as ingredients (Sáyago *et al.*, 2011). The use of citrus sector byproducts has long been of particular interest to the food industry. These are primarily utilised for animal feeding, although their high fibre content suggests they might make for an intriguing DF source (Marín *et al.*, 2007). When compared to other forms of dietary fibre, including cereals, the main benefit of citrus dietary fibre from citrus fruits is their larger proportion of soluble DF (Garau *et al.*, 2007). Citrus fruits are also superior to other dietary fibre sources because they contain related bioactive chemicals (flavonoids and vitamin C) with antioxidant properties that may have a greater impact on health than the dietary fibre itself (Lario *et al.*, 2004).

This study's objective was to determine the chemical composition of dietary fibre preparations made from citrus fruit residues (Sweet lime). The effects of their incorporation at different levels (0, 5 and 10 %) on the physical and sensory parameters of biscuits were also determined.

Table 1: Proximate Composition of Sweet Lime

Proximate Composition	Values (per 100gm)
1. Total Fat	0.2 gm
2. Sodium	2 mg
3. Potassium	102 mg
4. Total Carbohydrates	11 gm
5. Dietary Fibre	2.8 gm
6. Sugars	1.7 gm

METHODOLOGY

Materials:

The experiment was carried out in 2022–2023 at Parul University Vadodara in Gujarat's Parul Institute of Applied Sciences. Sweet lime, Oats flour and other ingredients used for biscuit preparation were purchased from the local market.

Obtaining citrus (Sweet Lime) dietary fibre preparations:

Sweet lime fibre preparation was obtained by cutting of whole fruit, pressing of juice and residue chopping. Drying was carried out in a dryer at 65°C for 6 hours. A grinder mill and sieves (60-mesh) were used to obtain uniform particle size and stored at room temperature till further analysis.

Preparation of Oats Flour:

Oats were roasted in a aluminium vessel for 10 minutes. It was further cooled and milled in a mixer grinder. To get uniform particle size, the flour was passed through a 60- mesh sieve and stored at room temperature conditions till further analysis.

Chemical Analysis:

Moisture, Fat, Protein, Carbohydrates, Energy, Dietary Fibre contents of the biscuits were determined by methods described by AOAC (1990).

Microbiological Analysis:

Total Plate Count, Yeast and Mould Count and *E. coli* Detection Tests of the biscuits were determined by the methods outlined in a compendium of methods for the microbiological examination of foods (AMPH, 1992) with some modifications.

Preparation of Biscuits:

Biscuits made from Oats were served as control sample. The Citrus DF preparations (Sweet Lime) were incorporated into biscuits at 3 different levels (0%,5%,10%) by replacing the equivalent amount of oats flour of biscuit mixture. The biscuits prepared were circular in shape with thickness of 0.25cm and diameter of 5cm. Biscuits were baked at 150°C for 15-20 min, for 10 min and packed in Ziplock bags.

Physical Analysis:

Diameter and thickness were measured with a vernier calliper at two different places and then average was calculated. The spread ratio was calculated using the formula:-diameter of the biscuits divided by the height of the biscuits.

Sensory Analysis:

Sensory evaluation of biscuits with incorporated DF preparations and without them (marked as control) was carried out regarding the consumer acceptance and preference using 3 trained panellists. Taste, Colour, Aroma, Flavour, Appearance of the products were rated using a 9 point hedonic scale where 9 and 1 represent extremely like and extremely dislike, respectively.

RESULTS AND DISCUSSION

Physical Analysis of Biscuits:

Table 2 shows the result of the physical analysis of

biscuits. The width and diameter of the selected sample was found to be 5 mm and 40 mm respectively. The spread ratio was found to be 8.2.

Table 2 : Physical Analysis of biscuit

Sample	Weight (g)	Height (mm)	Diameter (mm)	Spread Ratio
S1	8	5	40	8.2

Chemical Analysis of Biscuits:

Table 3 shows the result of the chemical composition of the biscuits. It was discovered that biscuits made with 5% citrus dietary fibre were superior in nutrition to those made with oat flour. The moisture content of the biscuits was found to be 3.1%, which indicates more shelf life of the product. The fat content was found to be 24.8g/100g, the protein content was found to be 5.4g/100g which maintains the protein percentage in the biscuit. The Dietary fibre and carbohydrate content of the product was found to be 9.32g/100g and 65.8g/100g, respectively. The energy content of the biscuits was found to be 508Kcal/100g. Incorporation of citrus dietary preparation to the biscuits increased its nutritional composition.

Table 3 : Result of Chemical Analysis of biscuits

Parameters	Units	Results
Moisture content	%	3.1
Fat	g/100g	24.8
Protein	g/100g	5.4
Carbohydrate	g/100g	65.8
Energy	Kcal/100g	508.0
Dietary Fibre	g/100g	9.32

Microbiological Analysis of Biscuits:

The results of the microbiological quality analysis are provided in Table 4. The results obtained for Total Plate Count and Yeast and Mould Count were 14,100 cfu/g and <10 cfu/g which are negligible in the selected biscuit sample. None of the sample had apparent yeast or mould growths. As a result, there is no chance that the sample will be contaminated by faeces, which is a sign of good production and handling procedures. This might possibly be as a result of how dry the sample were (Ezeama, 2007).

Table 4 : Result of Microbiological Analysis of Biscuits

Parameters	Units	Results
Total Plate Count	Cfu/g	14,100
Yeast and Mould Count	Cfu/g	<10
E. coli Detection	Per g	Absent

Sensory Analysis of Biscuits:

The sensory results are mentioned in the Fig. 1. The sensory properties of the product are greatly affected by DF enrichment, in addition to the product's general properties (Nurdin *et al*., 2005). The biscuits' flavour was significantly influenced by citrus DF preparations, but there were no noticeable differences in sweetness between the control sample and the DF-enriched (5%) biscuits. Citrus DF preparations were much more bitter when added to biscuits at a (10%) concentration. The general acceptance of biscuits reduced as the proportion of citrus DF in the formulation raised.

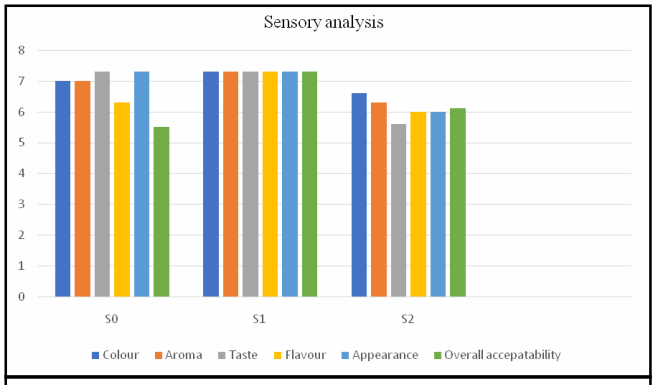

Fig. 1 : Graph representing sensory analysis

Conclusion:

In this study, the efficacy of citrus by-products (sweet lime) as a source of DF for biscuit production was assessed. The biscuits were found to be a rich source of protein and dietary fibre through chemical analysis. According to the results of the sensory evaluation, citrus DF preparations can be added to biscuits at a replacement level of 5% without significantly degrading the quality of the biscuits. Even while biscuits with higher citrus DF preparation additions (10%) are richer in biologically active ingredients like DF, their physical and sensory qualities could deteriorate. In conclusion, citrus DF preparations may be thought of as a potential functional ingredient in biscuits and other sweet bakery goods like cakes and muffins.

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