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# Nutritive Cookies by the Addition of Oligosachharides and Pectin

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**ABSTRACT:** This study aimed to create healthier cookies by adding prebiotic substances, fructo-oligosaccharides (FOS) and pectin. These prebiotics promote beneficial gut bacteria and resist stomach digestion. Seven trials were performed by adding FOS and pectin to the cookie formulation. After seven trials, a formulation with 10g FOS, 2g pectin, and 10g sugar was chosen based on sensory preferences. 9-point hedonic scale was used for sensory analysis and analysis was performed by trained and semi trained panel members. Addition of FOS and pectin has affected the textural properties of the cookie. Texture became harder as the pectin concentration increases. Proximate analysis of the optimised cookie formulation was 54% carbohydrates, 23% fat, 16.5% protein, 3.32% moisture, 2% pectin, and 1.1% ash. This innovative approach caters to the rising demand for healthier food choices.

**KEYWORD:** Prebiotics, Fructo- oligosaccharides, Non-digestible substances, Proximate analysis, Pectin.

## I. INTRODUCTION

The study focuses on improving the nutritional value of cookies, a widely consumed snack, by incorporating prebiotics (fructo-oligosaccharides or FOS) and pectin. It highlights the importance of bakery goods in modern lifestyles and the opportunity to make them healthier. The manufacturing process of cookies involves three key stages: creaming, liquid incorporation, and flour addition, which collectively determine their characteristics, such as texture and flavour. The role of essential ingredients like fat, sugar, liquid, flour, and baking powder in shaping the cookies' properties is explained.

Prebiotics, specifically FOS, are discussed as non-digestible food components that promote the growth of beneficial gut bacteria, contributing to overall health. These prebiotics are classified into different types, including fructus, galacto-oligosaccharides, resistant starches, pectic oligosaccharides, and non-carbohydrate oligosaccharides, each with unique attributes and sources. The study emphasizes the rising consumer interest in functional foods, which offer health benefits beyond basic nutrition.

Additionally, pectin's significance in food and non-food industries is highlighted, with a focus on its ability to form gels in the presence of calcium ions and maintain solubility at low pH. Pectin's diverse applications in jams, jellies, bakery products, and more are explained. The study also mentions potential health benefits associated with pectin, such as its role in shortening coagulation time, reducing blood cholesterol levels, and exhibiting antimicrobial properties. Finally, it explores various combinations and substitutes that can be used in cookies to cater to specific dietary preferences, including gluten-free options, vegan alternatives, and protein-enriched variations.

## II. RELATED WORK

A prebiotic is a non-viable food component that confers a health benefit to the host associated with the modulation of microbiota. Prebiotics will have healthy effect to host through bacterial fermentation in colon said by Gibson, M et. al.,[4]. Prebiotic ingredients are normally restricted to certain carbohydrates i.e non digestible oligosachharides that are distinguished from other carbohydrates for being resistant to digestion in stomach and small intestine. These lines were reported by Playne et.al.,[2]



Fructo-oligosaccharides (FOS), a type of prebiotic, are fermented in the large intestine, producing short-chain fatty acids like acetate, propionate, and butyrate mentioned by Brighenti Furio et. al.,[10]. Sanghamithra Kumar et. al.,[3] stated that FOS are found in various foods like asparagus, garlic, and banana. Dietary fiber’s viscous and fibrous structure can control the release of glucose with time in the blood, thus helping in the proper control and management of diabetes mellitus and obesity FOS can also help in mineral absorption and control blood glucose levels, making them beneficial for diabetes and obesity management Bennett et.al.,[1]. Many other health benefits of FOS was given in[7], [10], [11].

Pectin, another dietary component, has health benefits as well. It influences cholesterol levels, acts as a prophylactic against toxic cations, and can be used to treat iron deficiency anaemia was discussed by Tasnim Farzana, Suman Mohajan[7]. Pectin also shows promise in the treatment of ulcers and cancer due to its effects on angiogenesis was concluded by Crystal L Jackson et. al.,[8]. Additionally, it serves as a substrate for beneficial gut microorganisms, leading to the production of short-chain fatty acids that promote overall human health.

These findings underscore the importance of prebiotics like FOS and pectin in maintaining a healthy gut and their potential to impact various aspects of human well-being.

### III. METHODOLOGY

**Ingredients:** Wheat flour, Sugar, Fructo-oligosaccharides, pectin, butter, milk powder, baking powder & water.

**Materials and Equipment Required:** Flour, sugar, butter, milk powder, and baking powder are sourced from the local market. Fructo-oligosaccharides and pectin are ordered online.

- **Baking Oven:** Used for baking cookies at a set time and temperature.
- **Steel Vessels:** Used for mixing ingredients and forming dough.
- **Whisker:** Used for beating butter.
- **Moulds:** Various Molds for shaping the cookie dough.
- **Pulveriser or Grinder:** Used to grind fructo-oligosaccharides, flour, and sugar.
- **Sieve:** For removing unwanted particles in dry ingredients.
- **Weighing Balance:** Used to measure ingredient quantities accurately.

**Method of Preparation:** Seven number of trails has been performed using response surface methodology. Ingredients like wheat flour, butter, baking powder, and milk powder added in same quantities for all trails and they are added as follows:

- Wheat flour - 100gm
- Butter - 45gm
- Baking powder - 2gm
- Milk powder - 7gm

Fructo-oligosaccharides, sugar, pectin is added to the formulation and varied among the trails to know the best composition that gives good results. These ingredients are added as follows:

Trail	FOS (g)	Pectin(g)	Sugar(g)
1	20	20	3.75
2	10	30	0.5
3	30	10	0.5
4	10	30	7.0
5	15	25	1.5
6	20	20	2.5
7	10	30	4.5

**Table. 1. Composition of Trails**  
(FOS- Fructo oligosaccharides)

Wheat flour is sieved to remove impurities. Butter is beaten until it turns pale yellow. Sugar is ground into a powdered form. Baking powder and milk powder are added to the butter-sugar mixture. Fructo-oligosaccharides are mixed with sieved flour and ground to a fine powder. The flour-fructo-oligosaccharides mixture is added to the butter mixture along with water to form a dough. Cookie Shaping and Baking The dough is spread as a sheet on a tray or plate. Moulds of various shapes are used to shape the dough. The shaped dough is placed on a baking tray. The oven is preheated to 160°C, as fructo-oligosaccharides are temperature-resistant up to 160°C. The cookies are baked at 160°C for 20 minutes. After baking, the cookies are weighed to determine their final seven.

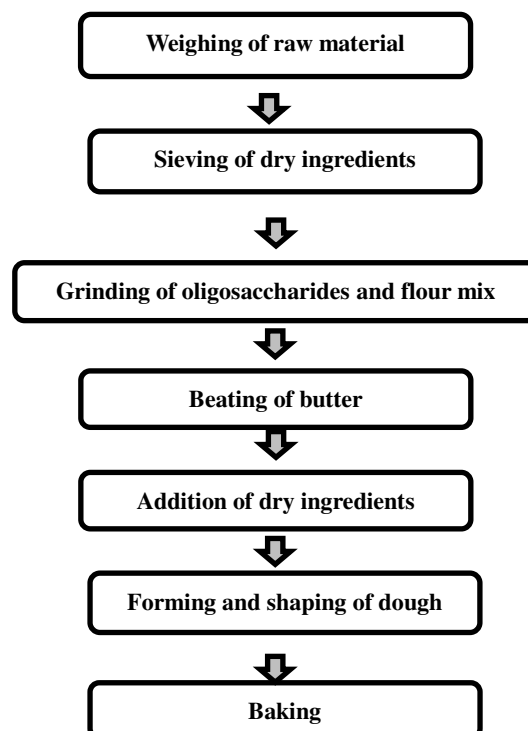


Figure. 1. Preparation Process Flow Sheet

#### ANALYSIS:

**Sensory Analysis:** Sensory analysis was done by using 9-point hedonic scale. samples were given to three different semi trained panel members. Each panel member was requested to rate the sensory attributes like colour, taste, texture, flavour and overall acceptability from 9-1 which denotes like extremely to dislike extremely.

#### Proximate Analysis:

**1. Moisture Content:** Sample is heated under specified conditions & weight loss is calculated as the moisture content of the sample.

**2. Ash Analysis:** At higher temperatures all the organic substances burnt and minerals left in the crucibles as ash content.

**3. Protein Analysis:** Nitrogen content in the food material is determined through kjeldhal method.

**4. Fat Analysis:** Fats/lipids are insoluble in the inorganic solvent i.e., water but soluble in organic solvents i.e., petroleum ether. Through distillation process this solvent and the fat is separated.

**5. Carbohydrates Analysis:** Absorbance of sample is measured using spectrophotometer/calorimeter.

**6. Pectin analysis:** Pectin is precipitated as calcium pectate by the addition of calcium chloride to an acid solution. After thoroughly washing to eliminate chlorides ions, the precipitate is dried and weighed.

#### IV. EXPERIMENTAL RESULTS

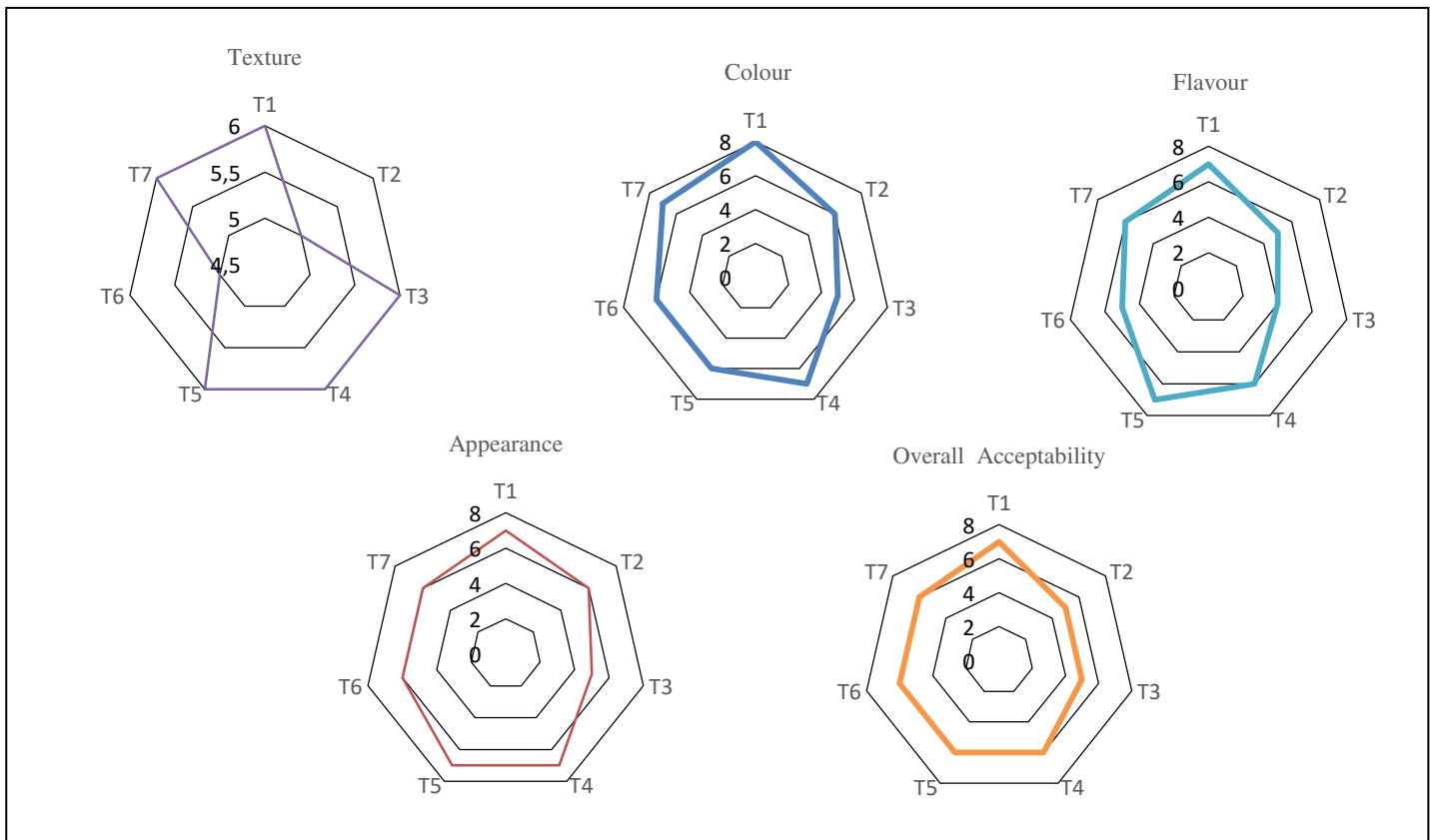
Seven trials were conducted using Response Surface Methodology, and the trial with the best sensory preferences was chosen for further analysis. Proximate analysis was performed on this trial to assess its nutritional composition. Sensory results were given in the table. 2. Among seven trails, T1 has high overall acceptability. Trail 1 has FOS of 20g, pectin



of 20g, 3.75g sugar. As the pectin content raises cookie becomes more harder, as the content FOS and pectin increases sugar addition will be decreased which effected the taste of the cookie.

Sample	Colour	Texture	Flavour	Appearance	Overall Acceptability
T1	8	6	7	7	7
T2	6	5	5	6	5
T3	5	6	4	5	5
T4	7	6	6	7	6
T5	6	6	7	7	6
T6	6	5	5	6	6
T7	7	6	6	6	6

**Table. 2. Sensory Evaluation**  
(T1-Trial 1, T2-Trial 2, T3-Trial 3, T4-Trial 4, T5-Trial 5, T6-Trial 6 & T7-Trial 7)



**Figure. 2. Sensory Graphs**

**Proximate analysis**

Cookie sample was analysed for different parameters namely moisture content, carbohydrate content, protein content, fat content, ash content. Results of proximate analysis were shown in the table. 3.

**Carbohydrates:** Our research involved creating a standard graph for dextrose solutions, which allowed us to determine the carbohydrate content in a sample with an absorbance of 2.5281 at 620nm. This revealed that the sample contained

54% carbohydrates. This increase was due to the addition of pectin and fructo-oligosaccharides, indicating a significant impact on product composition. Carbohydrate content of the cookie sample includes FOS and pectin also.

**Protein:** In the Kjeldahl method, we followed three stages: digestion, distillation, and titration. This method helped us determine that the sample contained 3.095% nitrogen. It's well-known that proteins in agricultural products typically consist of 16% nitrogen. Using a conversion factor of 5.33 for wheat, we calculated the protein content as 16.5%. Importantly, the addition of fructo-oligosaccharides and pectin did not significantly affect the protein content in the cookies.

**Fat:** We determined the fat content in samples using a non-polar solvent and found it to be 1.15 grams in a 5-gram sample, equivalent to 23% in a 100-gram sample. According to the article "Utilization of Corn Fiber and Pectin Gel for the Development of Low-Calorie and High-Fiber Biscuits," it's possible to replace fat with pectin gel up to 20% in fiber-rich biscuits. This replacement can significantly reduce the fat content in high-fiber corn biscuits, offering a dual benefit to consumers: lower fat intake and higher fibre content.

S.no	Test	Result
1	Carbohydrates content	54%
2	Protein content	16.5%
3	Fat Content	23%
4	Ash content	1.1%
5	Moisture content	3.32%
6	Pectin content	1.44%

**Table. 3. Results of Proximate Analysis**

**Ash:** Two samples from the same trial were tested, and due to high temperatures, organic substances burned off, leaving behind ash. The ash content in 100 grams of cookies was found to be 1.1%. Notably, the addition of fructo-oligosaccharides and pectin did not significantly impact the ash content. This is because the mineral content in the cookies primarily comes from wheat flour and milk powder, which remained consistent.

**Pectin Content:** Pectin is precipitated as calcium pectate by the addition of calcium chloride to an acid solution. After thoroughly washing to eliminate chlorides ions, the precipitate is dried and weighed. After drying and weighing the pectin content in the sample is found to be 1.44%. By addition of pectin to the cookies texture become hard and acceptability is gradually decreased.

## V. CONCLUSION

Health-enhanced cookies containing fructo-oligosaccharides (FOS) and pectin were developed, aiming to provide health benefits to consumers of all ages. Seven trials were conducted with varying concentrations of FOS (5% - 20%), pectin (0.25% - 3.5%), and sugar (5% - 20%). The trial with 10g FOS, 2g pectin, and 10g sugar was chosen for proximate analysis, revealing a nutritional content of carbohydrates (54%), fat (23%), protein (16.5%), moisture (3.32%), pectin (2%), and ash (1.1%). These cookies maintained good colour, taste, and texture, albeit with a slightly harder texture due to pectin. The balanced taste, achieved by combining sugar and low-calorie FOS, makes these cookies suitable for individuals at risk of or in the early stages of diabetes. The cookies' colour remained consistent, despite differences observed at varying baking temperatures. This optimal composition of 10g FOS, 2g pectin, and 10g sugar presents a nutritious and palatable option for health-conscious consumers.

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