

Prebiotic attributes of inulin enriched biscuits: sensory and nutritional aspects

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Abstract. The study aims to develop an enriched functional biscuit with prebiotic inulin and to understand the impact of addition of different levels of inulin on sensory and nutritional properties of the biscuits. A standard biscuit and three variations namely P1, P2 and P3 were formulated and standardized through test and trial method to get consistent final products. Inulin was added replacing fat in the standard-0%, P1- 100% P2-62% and P3-37%. The biscuits were evaluated by 15 panel members for sensory attributes i.e. appearance, colour, flavour, taste, texture and overall acceptability. Nutrients analysis for energy, carbohydrate, protein, fat, fibre, free fatty acid and total antioxidant activity were done using standard procedures. Addition of inulin can give rise to products with different rheological behaviour and sensory characteristics. P2 (62% fat replaced) was acceptable with a high score for overall acceptability (7.45 ± 0.39). Fat content was found to be highest in P3 (25.88gm). The inulin content in P1, P2 and P3 was 25.7gm, 34.5gm and 19.1 gm respectively. Antioxidant activity was also observed in all the biscuits and activity was highest in P2 (229.54 μ g). The partial replacement of fat by inulin in the production of biscuits was effective in reducing the fat content in the final product. A significant difference in taste ($p=0.004$) and texture ($p=0.048$) was observed among the biscuit variations. The formulation P2, with 62 % fat replacement by inulin, presented similar results to the standard product, being the formulation with the greatest sensory acceptance and physical characteristics.

1. Introduction

The changing trends in eating habits have made food production to take a pivotal role in promoting health. Increased energy intake, unbalanced diets and highly processed foods are huge problems of concern as these are contributory factors causing lifestyle diseases. The trend in the demand of functional food providing both taste and health claim is increasing and attention is focused on development of enriched staple food or commonly consumed snacks which is widely accepted. Prebiotics is used as a functional food ingredient to enhance health and wellbeing [1]. An option to improve the intake of prebiotics is to fortify commonly consumed foods with prebiotics. Prebiotic ingredients such as inulin have the advantage that they can be added to a wide range of commonly consumed foods because of their technological properties [2]. Many studies have proved its role as a



good fat replacer for developing products with healthier properties with desired sensory characteristics. Excessive intake fast foods and processed foods which are loaded with dietary fats such as saturated fats and trans fats used in fast food outlets have a deteriorating effect on health. The possible health benefits of prebiotic inulin facilitated by its nutritional and technological properties can be help in developing appropriate dietary interventions to stem the tide of increasing lifestyle diseases linked to modern society. The study aims to develop an enriched functional biscuit with prebiotic inulin and understand the impact of addition of different levels of inulin on sensory and nutritional properties of the biscuits.

2. Materials and Methods

2.1 Selection of prebiotic foods

A baked food product was formulated using inulin as an adjunct to incorporate the prebiotic functionality into the product. Inulin extracted from the chicory root (*Cichoriumintybus*) was used as it offers dual benefit of improving the organoleptic quality and offer functional benefit [1]. Fructafit® HD inulin is a natural powdered ingredient extracted from chicory roots. It is classified as a dietary fibre and used in food industry for its remarkable functional properties such as the ability to act as a fat or sugar replacer [3].

2.2 Standardisation of prebiotic food

Biscuits were formulated with three variations using inulin as fat and sugar replacer. A standard biscuit and three variations namely P1 (Fat and sugar removed), P2 (62% fat replaced and 100% sugar replaced) and P3 (37% fat replaced). The biscuits were standardised through test and trial method for all the variations to get consistent final products.

The biscuits were evaluated for sensory attributes and were compared with standard. Fifteen judges evaluated the biscuits using a 9 point Hedonic Scale. Each attribute was assigned a numerical value for a subjective factor i.e. appearance, colour, flavour, taste, texture, and overall acceptability. The biscuits were evaluated and the results were recorded. The analysis of variance (ANOVA) test was performed in order to find out the significant differences between the variations for different sensory characters by using SPSS software

2.3 Nutrient Analysis

Analysis for the three variations P1, P2 and P3 was conducted for nutrients such as energy, protein, carbohydrate, fat, fibre, free fatty acid and total antioxidant activity using standard procedures. Carbohydrate was analyzed using Anthrone method. Kjeldhal method of protein estimation was used to determine the protein content, fat was estimated using soxhlet method, free fatty acid content was estimated using AOAC: 2012 method and total antioxidant activity in the biscuits were analyzed using FRAP method. Inulin content was estimated using DGHS method. The nutrient content of inulin was analyzed separately for carbohydrate, fat, fibre and total antioxidant activity.

3. Results

It was noted that addition of inulin changes the physical characteristics of the biscuits. Similar findings by Kuntz *et al* 2013 demonstrated that addition of inulin alters the physiochemical and sensory characteristics in foods [4]. Incorporation of inulin changes the dimensions and aeration of the biscuit. On baking, increase in fat replacement resulted in reduction in the size of the biscuits compared to the standard formulation and consequently giving a more firm and crispy final product. The physical change can be associated with the ability of elastic recoil presented by inulin [5].

3.1 Sensory evaluation of the prebiotic biscuits

It can be noted that there was no significant difference in sensory attributes such as appearance ($p=0.15$), colour ($p=0.69$), flavour ($p=0.10$) and overall acceptability ($p=0.26$) among three variation of biscuits prepared with inulin and the standard. A significant difference in taste ($p=0.004$) and texture ($p=0.048$) and was observed among the biscuit variations. The mean acceptability scores for appearance, taste and texture attributes among the three variations were highest in P2 (7.45 ± 0.69 ; 7.80 ± 0.60 ; 7.45 ± 0.44). Maximum scores for colour attribute were noted in P3 (7.75 ± 0.44). The mean score for flavour was observed to be similar in all the variations. It can be observed that among the fat replaced P1, P2 and P3, P2 was acceptable with a high score for overall acceptability (7.45 ± 0.39) and hence P2 presented better results among the three variations and was accepted. Partial replacement of fat with inulin in the development of biscuits resulted in formulations of biscuits with better sensory acceptance and physical characteristics [6].

Table 1. Mean acceptability scores of standard and inulin biscuits.

Biscuit	Appearance	Colour	Taste	Texture	Flavour	Overall acceptability
Standard	7.50 ± 0.51	7.35 ± 0.59	7.85 ± 0.67	7.60 ± 0.51	7.40 ± 0.60	7.41 ± 0.14
P1	7.20 ± 0.62	7.60 ± 0.75	7.45 ± 0.51	7.25 ± 0.64	7.30 ± 0.83	7.40 ± 0.17
n=15						
P2	7.45 ± 0.69	7.65 ± 0.51	7.80 ± 0.60	7.45 ± 0.44	7.30 ± 0.70	7.45 ± 0.39
n=15						
P3	6.75 ± 0.44	7.75 ± 0.44	5.75 ± 0.44	6.75 ± 0.44	7.25 ± 0.44	7.18 ± 0.60
n=15						
F-value	1.821 ^{NS}	0.485	4.839*	2.70*	2.153 ^{NS}	1.343 ^{NS}

Values are mean \pm SD of the scores obtained

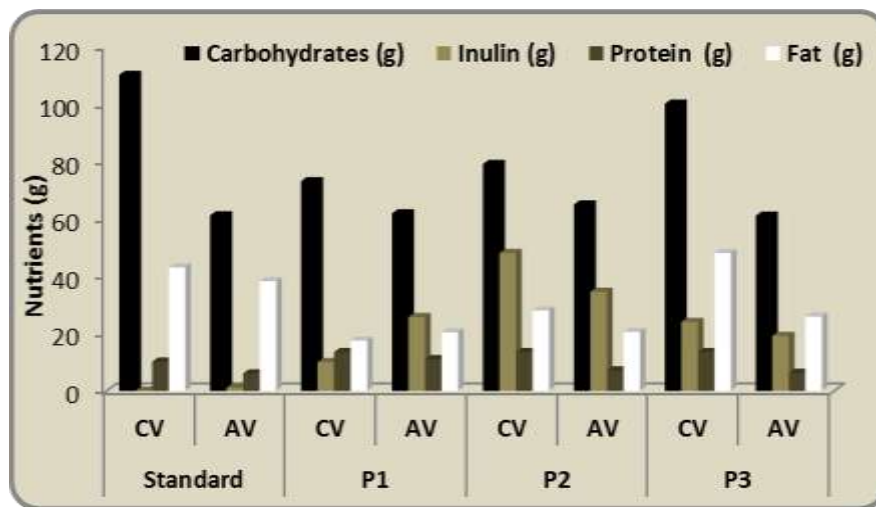
*- Significant at 5 per cent level ($p<0.05$)

NS- The difference between the mean values within the column is not significant.

P1 –Fat and sugar removed; P2- Fat replaced and sugar removed; P3-Fat replaced

3.2 Nutrients content of the prebiotic biscuits

Among the three variations, fat content was found to be highest in P3 (25.88 g) which can be attributed to the fat added in the formulation since only 32 per cent of fat used in the formulation was replaced with inulin hence higher fat content compared to P1 and P2. The protein content of standard biscuits (6.06 g) was found lower than that of the three biscuit variations (11 g, 7.08 g and 6.26 g for the variations P1, P2 and P3 respectively.) Prebiotic ingredient may have contributed to the protein content of the biscuits hence higher values were found in the variations compared to the standard. Crude fiber content of standard biscuits (0.45 g) was observed to be lowest.



AV- Analysed value; CV – Calculated value)

Figure 1. Nutrient composition

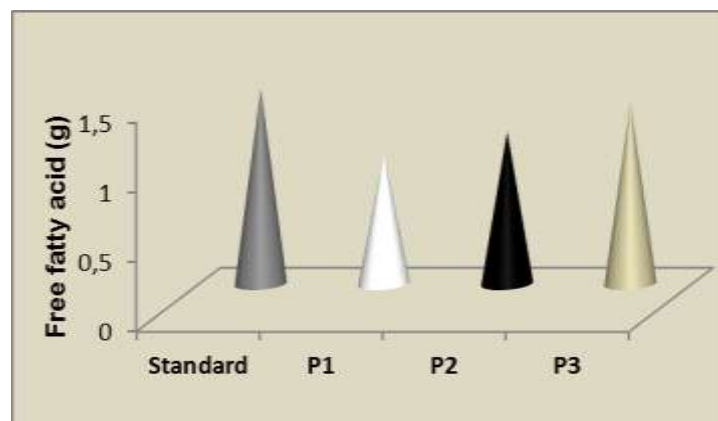


Figure 2. Free fatty acid content

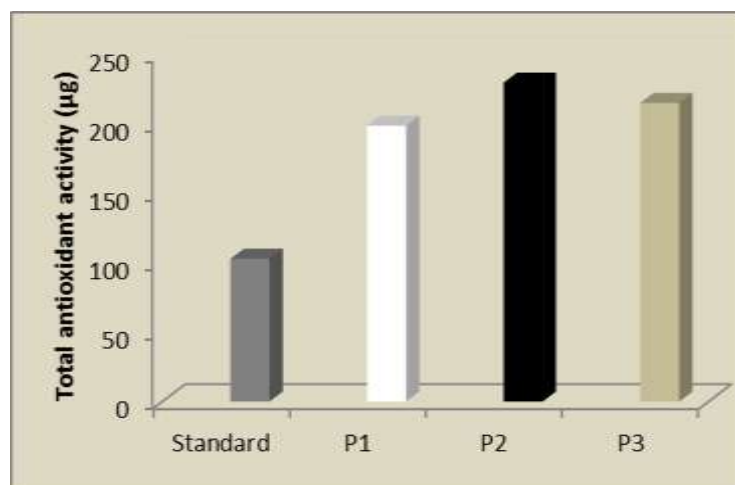


Figure 3. Total antioxidant activity

The inulin content in P1, P2 and P3 was 25.7 g, 34.5 g and 19.1 g respectively. The difference in the values may be attributed to the amount of inulin used in the formulation. Antioxidant activity was also observed in all the biscuits and activity was highest in P2 (229.54 µg). P1 and P3 showed an activity of 198.6 µg and 214.96 µg respectively. However standard biscuit showed the least activity (102.8 µg). Hence it can be inferred that incorporation of inulin in biscuits enhances the antioxidant activity. This observation is in line with a study by Pasqualetti *et al.*, 2014 which showed that antioxidant activity of inulin was significantly higher compared to simple sugars. The study concluded that the effects of inulin on the health of the host are attributable, not only to its bifidogenic [6]. Fats and oils are key ingredients in baked that confer desirable characteristics such as soft texture, aeration and flavour [8]. With the replacement of baking fat with inulin the free fatty acid content of the variations also decreased. Hence P3 (37% fat replaced) having the lowest replacement showed higher content of free fatty acid of 1.30 mg compared to P1 (0.93 g) and P2 (1.09 g).

4. Conclusion

The partial replacement of fat by inulin in the production of biscuits was effective in reducing the fat content in the final product. A significant difference in taste ($p=0.004$) and texture ($p=0.048$) was observed among the biscuit variations. Sensory attributes such as appearance, colour, flavour and overall acceptability was not significantly different among the variations and the standard. The formulation of P2, with 62 % fat replacement by inulin, presented similar results to the standard product, being the formulation with the greatest sensory acceptance and physical characteristics. Inulin presents as a versatile functional food ingredient with diverse applications which can be widely used in food industries. Fat and carbohydrate replacement with inulin can provide the advantage of delivering a nutritionally enhanced food product with health promoting benefits without compromising on taste and texture.

References

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